Distribution and abundance of harbour seals (*Phoca vitulina concolor*) and grey seals (*Halichoerus grypus*) in the Estuary and Gulf of St. Lawrence, 1994–2001

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ABSTRACT

Robillard, A., V. Lesage, and M.O. Hammill. 2005. Distribution and abundance of harbour seals (*Phoca vitulina concolor*) and grey seals (*Halichoerus grypus*) in the Estuary and Gulf of St. Lawrence, 1994–2001. Can. Tech. Rep. Fish. Aquat. Sci. 2613: 152 pp.

The abundance and distribution of harbour seals and grey seals in the Estuary and Gulf of St. Lawrence was assessed using seven aerial visual surveys of the Estuary, including three in June (1995, 1996, 2000) and four in August (1994–1997), and two surveys flown in June in different areas of the Gulf (1996 and 2001). Harbour seal counts at haul-out sites ranged from 389 to 659 individuals in the Estuary compared with 890 individuals for the regions surveyed in the Gulf. Assuming that the haul-out behaviour of harbour seals in our study area is similar to harbour seals in the eastern Pacific, where it has been estimated that about 50–75% of seals are hauled out during surveys, there may be approximately 4000–5000 harbour seals in the Estuary and Gulf of St. Lawrence. Trend analyses of the abundance of harbour seals in the Estuary since 1994 were inconclusive, owing to the small number of surveys available for the analyses.

A total of 111 to 723 grey seals were counted at haul-out sites in the Estuary, far fewer than the 2474 grey seals that were observed during the two surveys of the Gulf of St. Lawrence. No attempt was made to correct for the animals in the water. Haul-out counts varied widely between years, suggesting between-year changes in the use of this area by grey seals.

RÉSUMÉ

Robillard, A., V. Lesage, et M.O. Hammill. 2005. Distribution and abundance of harbour seals (*Phoca vitulina concolor*) and grey seals (*Halichoerus grypus*) in the Estuary and Gulf of St. Lawrence, 1994–2001. Can. Tech. Rep. Fish. Aquat. Sci. 2613: 152 pp.

L'abondance et la distribution des phoques communs et des phoques gris dans l'estuaire et le golfe du Saint-Laurent ont été déterminées à l'aide de sept inventaires aériens visuels de l'estuaire, dont trois ont été menés en juin (1995, 1996, 2000) et quatre en août (1994–1997), et deux inventaires menés en juin dans deux aires complémentaires du golfe (1996 et 2001). Le compte des phoques communs variait entre 389 et 659 individus dans l'estuaire, comparé à 890 individus pour les deux régions du golfe. En assumant que le comportement d'échouerie des phoques communs dans notre aire d'étude est similaire est celui des phoques communs de l'est du Pacifique où il a été déterminé qu'environ 50–75% des phoques sont échoués au moment de l'inventaire, il pourrait y avoir de 4000 à 5000 phoques communs dans l'estuaire et le golfe du Saint-Laurent. Les analyses de tendance de l'abondance des phoques communs dans l'estuaire depuis 1994 ne se sont pas avérées concluantes compte tenu du faible nombre d'inventaires disponibles pour les analyses.

Un total de 111 à 723 phoques gris ont été dénombrés aux sites d'échouerie dans l'estuaire, beaucoup moins que les 2474 phoques gris qui ont été observés au cours des deux relevés complémentaires du golfe du Saint-Laurent. Une correction pour les animaux dans l'eau n'a pas été tentée. Ces comptes variaient beaucoup entre les années, suggérant des changements interannuels dans l'utilisation de la région par le phoque gris.

INTRODUCTION

The harbour seal (*Phoca vitulina*) is a small phocid (< 120 kg) comprising five subspecies, which are widely distributed throughout much of the northern hemisphere (Burns 2002). The species has a coastal distribution, with individuals hauling out regularly on a variety of substrates, including exposed reefs, rocks, sand bars, and ice (Mansfield 1967a; Boulva and McLaren 1979; Bigg 1981). Harbour seals are believed to be relatively sedentary throughout the year (Stewart and Yochem 1994; Bjørge et al. 1995; Thompson et al. 1996; 1998; Lowry et al. 2001). However, a capacity to undertake long-distance migrations as part of the annual activity/distribution cycle has been demonstrated among adults of this species (e.g., Pitcher and McAllister 1981; Harvey 1987; Gjertz et al. 2001; Lesage et al. 2004). In Atlantic Canada, the subspecies *P. vitulina concolor* whelps and breeds during May–July and moults during July–September (Boulva and McLaren 1979; Schneider and Payne 1983; Dubé et al. 2003; V. Lesage and M.O. Hammill, unpublished data). Unlike most phocids, harbour seal pups enter the water soon after birth and move between haul-out sites during the lactation period (Knudtson 1977; Lawson and Renouf 1985). Females in some areas show a strong fidelity to their natal site (Bowen et al. 2001a; Härkönen and Harding 2001).

The grey seal is larger than the harbour seal (weight = 200–300 kg) and is found in coastal areas throughout the North Atlantic (Hall 2002). Like the harbour seal, grey seals also prefer to haul-out on small isolated islets, sandbars, reefs, and rocks exposed at low tide. Reproduction in Atlantic Canada occurs during winter (December–February), with two large breeding colonies found on the ice in the southern Gulf of St. Lawrence and on Sable Island off the coast of Nova Scotia (Mansfield and Beck 1977; Boulva and McLaren 1979). Moulting occurs during May and June (Stobo et al. 1990; Beck et al. 2003). At that time or shortly after the moult, animals move away from their breeding sites, dispersing along the northeastern United States, the Nova Scotia and Newfoundland coasts, throughout the Gulf of St. Lawrence, and into the St. Lawrence Estuary (Stobo et al. 1990; Lavigueur and Hammill 1993).

In Atlantic Canada, grey seals and harbour seals are often observed hauled-out in the same general area. However, observations of large numbers of both species occupying the same site are rare, and there are indications that the two species might compete for haul-out space or food resources (Bowen et al. 2003a). Grey seal numbers in Atlantic Canada have increased over the last four decades (Mohn and Bowen 1996; Hammill et al. 1998; Bowen et al. 2003b), while trends in harbour seal numbers or even point estimates of abundance are largely undocumented (Stobo and Fowler 1994; Bowen et al. 2003a; Waring et al. 2003; Gilbert et al. 2005). In one of the few areas where long-term data exist for harbour seals, their numbers have drastically declined during the 1990s, concomitant with the exponential growth of what is now considered the largest colony of grey seals in the world, who share Sable Island as a haul-out site with harbour seals (Lucas and Stobo 2000; Bowen et al. 2003a).

Preliminary studies of the abundance and distribution of harbour seals and grey seals in the St. Lawrence Estuary using systematic boat and aerial surveys were conducted in 1991–1992 and 1994 (Lavigueur et al. 1993; Lesage et al. 1995). This report extends these databases by presenting a detailed analysis of harbour and grey seal abundance and distribution in the Estuary and Gulf of St. Lawrence Estuary, based on seven aerial surveys of the Estuary (1994–2000) and

two surveys of the Gulf (1996 and 2001). Although the current study was designed specifically for harbour seals, we also present data on grey seal abundance and distribution.

MATERIALS AND METHODS

STUDY AREA

St. Lawrence Estuary and Saguenay River

The St. Lawrence Estuary extends over 350 km, from Île d'Orléans in the west to Pointe-des-Monts / Ste-Anne-des-Monts in the east (Figure 1). The Estuary is naturally divided into two regions, hereafter called the Upper and Lower Estuary, which are delimited by the confluence of the Saguenay River along the north shore, and Cacouna along the south shore (El-Sabh and Silverberg 1990). Water depths in these two portions of the Estuary vary greatly, from 20–50 m upstream of the Saguenay River to 350 m downstream in the Laurentian Channel. The Laurentian Channel ends abruptly at the confluence of the Saguenay River, resulting in an upwelling of cold, saline, mineral-rich water, which accounts for the high biomasses of phytoplankton and the relatively high productivity of the area (El-Sabh and Silverberg 1990). Tides are semi-diurnal in the two portions of the Estuary and the Saguenay River but are of slightly larger amplitude in the Upper Estuary (mean range = 4.5 m; max. range = 6.3 m) compared with the Saguenay River (mean = 3.8 m; max. = 6.3 m) or the Lower Estuary (mean = 3.0 m; max. = 4.6 m) (Hydrographic Service of Canada 2000: their Table 1).

In spite of a marked difference in bathymetry and salinity between the Lower and Upper Estuary, coastline characteristics are remarkably consistent between the two regions. The north shore of both the Upper and Lower Estuary is generally characterized by a steep coastline and deeper waters, with limited littoral zones (Figure 1). The 15-m isobath, which has been used as an indicator of haul-out site availability (Lesage et al. 1995), usually lies within 2 km of the north shore. The only exceptions are areas around Baie-Comeau and Batture aux Alouettes, where the 15-m isobath extends 5 km offshore and where extensive sandbars are exposed at low tide. In contrast, the south shore of the Upper and Lower Estuary is characterized by a more progressive slope, shallower waters, and the presence of several islands. The 15-m isobath often lies 4–5 km away from the coast in this area. The Saguenay River is a fjord characterized by steep cliffs with occasional rocks at their edges, few bays, and deep waters (up to 275 m) (Drainville 1968).

Gulf of St. Lawrence

The Gulf of St. Lawrence is a semi-enclosed sea extending over approximately 240,000 km^2 (Figure 2). The Esquiman and Laurentian channels allow Atlantic and Labrador shelf waters to enter the Gulf at depth through Cabot Strait and the Strait of Belle Isle. These inflows in combination with tides, freshwater runoffs, seasonal ice cover, and exchanges with the atmosphere result in an internal cyclonic circulation and yearlong stratification in the Estuary and western Gulf. Based on physical characteristics, the Gulf of St. Lawrence can broadly be

divided into three areas: (1) a shelf along the north shore, with a rocky bottom and mean depths of 50–70 m, and which is strongly influenced by the upwelling of cold waters from the Labrador Current; (2) the channels (Laurentian and Esquiman), with average depths of 420 m; and (3) the southwestern shelf, characterized by warmer waters and sandy bottoms at depths of ca. 50 m (Saucier et al. 2003). Salinities in the Gulf are high (> 28) and biological productivity is unusually high relative to open seas (Therriault 1990). Tides are of lesser amplitude than in the Estuary, with mean amplitudes varying between 0.7–2.3 m (max = 1.1–3.7 m) depending on the area (Hydrographic Service of Canada 2000: their Table 1).

The characteristics of the coastline vary greatly among areas in the Gulf of St. Lawrence. The north shore has characteristics similar to the Estuary, with steep coastlines and limited littoral zones east to approximately Sept-Îles, where small islands and reefs become more numerous along the shore. The Gaspé Peninsula and the west coasts of Cape Breton and Newfoundland are characterized by steep coastlines and relatively few islands, reefs, or bays. Coastlines in the Baie des Chaleurs and the southwestern Gulf are generally sandy, with limited littoral zones. Prince Edward Island, the north shore of Nova Scotia, and the Îles-de-la-Madeleine are also characterized by sandy beaches in several areas, while some steep sandy cliffs also shape their landscape.

AERIAL SURVEYS

The distribution and abundance of harbour and grey seals in the Estuary and the Gulf of St. Lawrence were determined using visual aerial surveys of coastlines, islands, and reefs during June, August, or both periods in 1994–1997, 2000, and 2001. In the St. Lawrence Estuary, surveys were flown between St-Jean-Port-Joli / Baie-St-Paul to the west and Métis-sur-Mer / Baie-Comeau (1994) or Ste-Anne-des-Monts / Pointe-des-Monts (1995, 1996, 1997, 2000) to the east (Figure 1). The survey area also encompassed a portion of the Saguenay River located downstream of Saint-Fulgence. In June 1996, the survey area was extended to include a portion of the Gulf of St. Lawrence, which encompassed the south shore from Ste-Anne-des-Monts to the entrance of Shediac Bay in New Brunswick, the Îles-de-la-Madeleine and Anticosti Island, and the north shore from Pointe-des-Monts to Natashquan (Figure 2). The shores of Prince Edward Island, which were not included in the study area in 1996, were surveyed in June 2001.

Surveys were flown from a Bell 206B (1994, 1995), Bolkow-105 (June 1996), or Bell 206L (August 1996, 1997, 2000, and 2001) helicopter with fixed floats (except in June 1996 when pop-outs were used). The aircraft was equipped with a GPS and was flown at an altitude of 152.4 m (500 ft) within 300 m of the coast at a cruising speed of 150 km/h (80 knots). Surveys were flown on days when visibility was good (no fog), with low to medium wind (Beaufort 3 or less). In the Estuary, tidal amplitude constrained the survey period to within approximately a 4-h window around the mid-morning low tide (Appendix I). The survey period was planned to comply with this constraint in the northern Gulf of St. Lawrence, where tides were still likely to affect the presence of harbour seals at haul-out sites at times other than near low tide (Hydrographic Service of Canada 2000; Appendix I). However, this was not the case in the southwestern Gulf of St. Lawrence and the Îles-de-la-Madeleine, where tidal amplitudes are small (< 1 m). In these areas, the survey period was restricted to a 3-h window around noon.

Although no data exist as to the main factors influencing the haul-out behaviour of harbour seals in the latter regions, studies in areas with tidal amplitudes similar to the southern Gulf of St. Lawrence indicate that numbers of harbour seals are expected to be maximum around noon (e.g., Simpkins et al. 2003). Survey dates were chosen to coincide with the pupping (Dubé et al. 2003) and moulting (V. Lesage and M.O. Hammill, unpublished data) seasons of harbour seals, and to obtain similar tidal characteristics across years, i.e., mid-morning low tide of medium-high amplitude on the first survey day. Although the survey conditions were similar during the pupping and moulting seasons, counts obtained during these two periods are not expected to be comparable because haul-out behaviour of pups, juveniles, and adult males and females varies between seasons (e.g., Brown and Mate 1983; Stewart and Yochem 1983; Jeffries 1985; Calambokidis et al. 1987; Thompson 1989; Härkönen et al. 1999; Jemison and Kelly 2001).

In the St. Lawrence Estuary and Saguenay River, the study area was covered in 3 days to minimize double counts and respect the time window: day 1) the south shore and middle estuary islands; day 2) the north shore; and day 3) the Saguenay River. The south and north shores of the Estuary were flown in an east to west direction so as to move with the tide and maximize the survey period. An exception to this pattern was the 1994 (August) survey of the north shore of the Estuary, which was flown against the tide from west to east, resulting in the eastern and western portions of the estuary being surveyed more than 2 h before and after low tide (Appendix I). The steep coastlines of the Saguenay Fjord required that the counts for the south and north shores be made while the aircraft flew upstream and downstream, respectively, above the water.

The 1996 survey of the Gulf of St. Lawrence was flown in five days: day 1) the western Gulf, flown from Ste-Anne-des-Monts on the south shore towards the east then south to the Miscou peninsula, including the Baie des Chaleurs; day 2) the southwestern Gulf, flown from Shippegan to Shediac Bay to the south; day 3) Îles-de-la-Madeleine, surveyed counter-clockwise from Cap-aux-Meules on the east side of Île du Cap-aux-Meules; day 4) Mingan Archipelago and Anticosti Island, with the Mingan Archipelago flown from Longue-Pointe-de-Mingan to Havre-Saint-Pierre, and Anticosti Island flown clockwise from Pointe-Ouest; day 5) the north shore, flown from Natashquan towards Pointe-des-Monts to the west. Prince Edward Island was the only area surveyed in June 2001, and the survey took 2 days: day 1) from Hillsborough Bay off Charlottetown on the south coast, then across the island to Covehead Bay on the north side, flying counter-clockwise along the coast back to Charlottetown; day 2) from Hillsborough Bay flying counter-clockwise to Savage Harbour (Figure 2). A count of pinnipeds in Hillborough Bay was obtained on both survey days; the average count was used in the analyses. The sectors of Percé and Île Bonaventure along the Gaspé Peninsula and Kouchibouguac Park (New Brunswick) were not surveyed due to restrictions on flights over bird sanctuaries. The Île Plate/Bonaventure sector and Kouchibouguac Park are known as concentration areas for pinnipeds during summer (Lavigne 1978; Boulva and McLaren 1979). Point estimates of the abundance of harbour and grey seals during the survey period in 1996 were provided by the authorities of the two parks (Mr. Paul Germain, Kouchibouguac Park; Mr. Donald Cahill, Observation Littoral Percé, Inc.). In these areas, animals at the haul-out sites were counted from a small vessel that visually surveyed the haul-out sites at low tide (Île Plate/Bonaventure) or near noon (Kouchibouguac Park).

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Initial approaches to determine the number of individuals in larger groups of harbour seals and grey seals were made at an altitude of approximately 200 m (650 ft) and 365 m (1200 ft), respectively. A count of the total number of seals present was obtained independently by two observers seated on the same side of the aircraft. Counts were compared between observers after a first pass to identify large discrepancies. Additional passes were made when necessary to obtain consistent counts between observers (i.e., ca ± 3, 10, or 25 individuals for groups <100, 100–250, >250 individuals). The mean of the best counts of the two observers was used in the final estimate. Each count was accompanied by information on time, the presence of harbour seal pups (June surveys of the Estuary only), type of substrate, whether the haul-out site was attached to land (beach, rocky bottom of a cliff), and the position of the individual seals (hauled out or in the water). The same two observers flew all of the surveys except in 2000 and 2001, when one observer was replaced by an experienced (2000) or an inexperienced (2001) observer.

DATA ANALYSIS

An estimate of the distance flown during each survey was calculated from a digital 1:250,000 scaled map (Lambert conformal conic NAD 83 projection) of the study area using the software Arcview GIS 3.2 and the extensions *split tool* and *1st tool* to fractionate the coastline and calculate its geometry (Environmental Systems Research Institute, Redlands, CA, U.S.A.). The total distances of coastlines and island perimeters were included in the calculations, resulting in greater distances flown in areas characterized by convoluted coastlines. A similar approach was used to determine the area not covered during these surveys in the Gulf of St. Lawrence. For these calculations, the Gulf of St. Lawrence was defined as the Northwest Atlantic Fisheries Organization (NAFO) Divisions 4R, 4S, and 4T, and thus included Natashquan along the north shore east to the Strait of Belle Isle, western Newfoundland, western and eastern Cape Breton, and Shediac south to Cape Breton (Figure 2). This index of distance flown during each survey approximates the flight path but represents only a crude approximation of the coastline and availability of haul-out sites.

The distribution patterns and abundance of harbour seals and grey seals were examined by grouping sightings into zones (Figures 3–8, 10, 12, 13). These zones were defined partly based on spatial discontinuity in the presence of the species but mainly on well-delimited topographic features easily definable and identifiable on bathymetric or topographic maps (island, banks or reef archipelago). The overall and seasonal importance of each zone for harbour seals and grey seals were examined in terms of both abundance (A) and regularity of occupancy (F) across survey years and seasons as:

$$A_{z,sp} = \sum_{i=1}^{n} N_i / n_z$$

$$F_{z,sp} = S / n_z$$

where N_i is the number of individuals of species *sp* counted in zone *z* during survey *i*,

n is the number of surveys conducted in zone z, and

S represents the number of surveys with at least one sighting of the species in zone z

Abundance indices were used to estimate rates of change in harbour seal and grey seal numbers in the St. Lawrence Estuary, assuming an exponential growth rate, i.e., the theoretical rate of increase of a population not subjected to density-dependence (Caughley 1977):

$$N_{t+1} = N_t e^r$$

where N is the estimated number of seals at time t and t+1, and r represents a rate of increase. Abundance estimates for each zone were not converted to densities because distance of coastline flown was used only as a crude approximation of the surface available for seals to haul-out and thus, would not reflect accurately the available haul-out space at such small scales.

Growth rates were estimated using survey estimates from June and August separately. Trends were examined for different sectors and for the study area as a whole (i.e., St. Lawrence Estuary). The high site fidelity of harbour seals permitted the examination of trends at major haul-out sites, which were surveyed < 1 h from low tide or at a time relatively similar (< 75 min difference) between surveys (i.e., Bic, Pointe Mitis, Batture aux Alouettes, and Île Blanche). A similar approach was not attempted for grey seals, since their use of the different haul-out sites varied widely among surveys and haul-out site fidelity does not appear to be as strong in this species (see Results; e.g., Goulet et al. 2001).

RESULTS

The abundance and distribution of harbour seals and grey seals in the Estuary and Gulf of St. Lawrence was assessed from nine surveys. Seven surveys were flown in the Estuary (June 1995, 1996, 2000; August 1994, 1995, 1996, 1997) whereas two surveys were flown in June 1996 and 2001 in two different areas of the Gulf of St. Lawrence (Figures 1 and 2). Surveys in the Estuary covered coastline distances of 1908 km except in August 1994 and June 1995, when the limits of the study area were less extensive to the east (August 1994) and fog limited survey efforts in the Saint-Fulgence area of the Saguenay River (June 1995). In the Gulf, a total of 4080 km and 1275 km of coastline were covered in 1996 and 2001, respectively. The 4-h survey window centered on low tide was generally respected during surveys of the Estuary (Appendix I). However, the large number of islands to survey along the south shore required that the 4-h window be extended to a 5-h window centered on low tide. Although this change did not affect survey times in the Upper Estuary (i.e., all sites were surveyed within 2 h of low tide), it did result in the portion of the Lower Estuary to the east of Métis-sur-Mer being surveyed 2–3 h before low tide in 5 of 6 surveys. The 4-h window centered on low tide could not be respected in 1994 for the Saguenay River due to bad weather and logistic reasons (survey during daylight and mid-day). The 4-h survey window was respected in most areas of the northern Gulf except along the south coast of Anticosti, where tidal amplitude was < 1 m and thus less likely to affect seal

numbers at haul-out sites (Appendix I). The southwestern Gulf and Îles-de-la-Madeleine were surveyed between 8:20 and 15:45, i.e., within ~3.5 h of noon.

During the nine aerial surveys of the Estuary and Gulf of St. Lawrence, only two pinniped species, harbour seals and grey seals, were observed in the study area. Both species were present in the Estuary and the Gulf, although some discontinuity in distribution was observed in both cases. Very few if any harbour or grey seals were observed along the north shore between Baie-Comeau and Longue-Pointe-de-Mingan or along the south shore of the Gaspé Peninsula between Matane and Forillon (Figures 3–6). Harbour seals also showed some discontinuity in distribution in the western Gulf, where only one individual was seen along the coast of New Brunswick, including Baie des Chaleurs. Grey seals were also generally absent from this area, with the exception of Kouchibouguac Park, where this species formed large aggregations (see below).

Differences in the abundance of harbour seals between the Estuary and Gulf of St. Lawrence were not as clear as for grey seals, which were generally less abundant in the Estuary than the Gulf of St. Lawrence (Tables 1 and 2). Harbour seal numbers in the St. Lawrence Estuary ranged from 389 (August 1994) to 659 individuals (August 1997), compared with 467 and 423 harbour seals observed in two different regions of the Gulf of St. Lawrence in June 1996 and 2001, respectively. In comparison, 111 (August 1994) to 723 (August 1995) grey seals were observed in the Estuary, far fewer than the 2474 grey seals (i.e., 2394 seals in the northern Gulf and 80 seals at PEI) that were observed during the surveys of the Gulf of St. Lawrence in 1996 and 2001. An additional 55 grey seals were reported in Kouchibouguac Park for the same period as the survey in 1996 (15 June), whereas 10–40 harbour seals and 20–25 grey seals were reported at Île Plate/Bonaventure from 10–16 June 1996 (Table 2). A small number of seals (1–5 ind. per survey in the Estuary; 36 ind. in the Gulf) could not be identified to the species and were not included in the totals per species (Table 1 and 2). Except in 1994, when the north shore of the Estuary was flown against the tide and when counts were the lowest, both species were more abundant in August than in June in the Estuary (Table 1). Similar comparisons were not possible for the Gulf of St. Lawrence since surveys were conducted exclusively during June.

In general, harbour seals were seen more frequently than grey seals. However, grey seals generally formed larger aggregations than harbour seals, as indicated by maximum counts (704 vs 206 ind.), mean counts (68.7 vs 23.5 ind.), 90th percentile (108 vs 70 ind.), and 95th percentile (492 vs 98 ind.) of grey seals vs harbour seals in the different zones of the Estuary and Gulf of St. Lawrence (n = 60 vs 42 zones) (Tables 3–6). Although harbour seals and grey seals rarely shared the same haul-out sites, they were observed regularly in the same zones. The two species shared 17 zones in the Estuary (Figures 3 and 4) and eight zones in the Gulf of St. Lawrence (Figures 5 and 6). However, some areas such as Kouchibouguac Park, Île du Corps Mort, and Île Brion near the Îles-de-la-Madeleine in the Gulf of St. Lawrence, and the mouth of the Betsiamites River, Île aux Fraises, Île Rouge, and the Razades in the Estuary were almost exclusively used by grey seals. The opposite was observed in areas such as the mainland of the Îles-de-la-Madeleine in the Gulf of St. Lawrence, and at Île Blanche, Hauts-fonds de Mille-Vaches, and Batture aux Alouettes in the Estuary, which were essentially used only by harbour seals. An examination of Appendices II.2.1 and III.2.1 reveals little if any overlap in the haul-out sites used by harbour and grey seals around Anticosti Island.

Detailed descriptions of the distribution and abundance of harbour and grey seals during each aerial survey are presented in Appendices II and III, respectively.

HARBOUR SEAL

St. Lawrence Estuary

The distribution of harbour seals was non-uniform among the different sectors of the Estuary but was similar in June and August. Harbour seals were observed from the western limit of the survey area, i.e., Battures aux Loups Marins to Matane and Godbout to the east, and to the upstream limit of the survey area in the Saguenay River at Saint-Fulgence (Figures 3, 7, and 8).

Harbour seals were generally more abundant in the Lower Estuary and along the south shore than in the Upper Estuary or the Saguenay River or along the north shore during each survey (*G*-tests of independence, $df = 2$, all $P < 0.001$; Table 7; Figure 9). Depending on the survey year and season, 58–71% of the harbour seals were observed in the Lower Estuary compared with 28–39% in the Upper Estuary and 0.2–7% in the Saguenay River. The majority (52–75%) of the harbour seals were also observed in the southern half of the Estuary including the mid-Estuary islands, with only 24–42% of the observations made along the north shore. Even though the relative importance of the different sectors were similar in June and August (i.e., the south shore and Lower Estuary held the majority of the harbour seals), the distribution of harbour seals among the different sectors changed between seasons. The proportion of individuals that used haul-out sites along the south shore or the Lower Estuary decreased from 60–75% and 61–67% in June to 52–64% and 58–62% in August, respectively, to the benefit of the Saguenay River colonies, where 1–7% of harbour seals were observed at that time compared with < 0.3% in June. During the two years when surveys were conducted in both June and August (i.e., 1995 and 1996), the increase in the proportion of harbour seals that used the Saguenay River was statistically significant ($\chi^2 = 14.8$ and 23.3, both $P < 0.001$).

Harbour seals used 95 different sites, including 57 sites located along the south shore and associated middle estuary islands, 20 sites along the north shore, and 18 sites in the Saguenay River. Of the 77 sites located in the Estuary itself, 22 were in the Upper Estuary and 55 in the Lower Estuary (Appendix II.1.2). The 95 haul-out sites were grouped into 38 zones, which varied in importance in terms of seal abundance and regularity of occupancy (Tables 3, 8, and 9; Figure 3). The zones of highest abundance included, in decreasing order of importance, the Bic archipelago ($\bar{x} = 98.0$; range = 72–128 ind.), Batture aux Alouettes ($\bar{x} = 87.3$; range = 66–123 ind.), Île Blanche ($\bar{x} = 68.7$; range = 37–104 ind.), Pointe Mitis ($\bar{x} = 59.1$; range = 46–71 ind.), Hauts-fonds de Mille-Vaches ($\bar{x} = 41.9$; range = 13–65 ind.), Batture de Tobin / Batture de l'Île Ronde ($\bar{x} = 31.7$; range = 13–46 ind.), and Batture aux Outardes ($\bar{x} = 30.1$; range = 12–59 ind.) (Table 8). Harbour seal numbers were consistently high at these sites between surveys (Table 3). Other zones were used by a lesser number of seals but were also used on a regular basis. These zones included Île Verte, Île aux Fraises, Battures aux Loups Marins, Battures aux Gibiers, and the portion of the Saguenay River located between L'Anse-Saint-Jean and Baie des Ha! Ha! (Tables 3 and 9).

Harbour seal pups were observed during the June surveys but could not be distinguished from one-year-old individuals in August. They were sighted in 16 of the 38 zones, including the most important harbour seal aggregation zones of Pointe Mitis, Bic archipelago, Batture de Tobin / Île Ronde, Île Blanche, Île aux Fraises, Battures aux Loups Marins, Batture aux Alouettes, Hauts-fonds de Mille-Vaches, and Île de la Mine (Table 8; Figure 10).

Based on surveys conducted during June and August of the same year (i.e., 1995 and 1996), harbour seals were consistently more numerous in August than in June, even when considering each sector separately (i.e., Lower vs Upper Estuary, Saguenay River, north vs south shore) (Table 7). The zones of highest abundance or of regular occupancy were generally the same in June and August (Tables 8 and 9). However, a decrease in the abundance of harbour seals between June and August was observed at Île aux Fraises, where large numbers of grey seals are found during August (see below; Table 8). Harbour seals used a smaller number of sites and zones in June (n = 60 sites in 30 zones) than in August (n = 74 sites in 35 zones), with some zones being used exclusively at one period or the other (Table 3; Figures 7 and 8). They were observed in June, but not in August, at Matane, Pointe-au-Père, Anse à Mercier, Île aux Pommes, and Île aux Basques. Areas exclusively used in August included four zones in the Upper Estuary (Battures de Kamouraska, Anse Sainte-Anne, Île aux Coudres, and Saint-Irénée), three zones from the Lower Estuary (Sainte-Luce, Batture à Théophile, bay of Pointe Rouge) and the sector between Baie des Ha! Ha! and Saint-Fulgence in the Saguenay River (Table 3).

Trends in the abundance of harbour seals in the Estuary were examined using the June (n = 3) and August (n = 4) estimates, first considering the study area as a whole, but also the different sectors separately and the four major haul-out sites (Table 10; Figure 11). Surveying the north shore against the tide in August 1994 most probably resulted in an underestimation of the number of seals along the north shore in the Lower Estuary, as indicated by their substantial numbers during the other surveys of this sector (Table 7). Therefore, the global estimate for August 1994 and those for the north shore and the Lower Estuary during this survey were not included in the analyses. In contrast, the estimate for the Upper Estuary was included in the analyses because it was probably unbiased: during the other six surveys, only one (harbour) seal was seen in the zone of the Upper Estuary not surveyed within 2 h of low tide (i.e., the north shore) (Table 3). Only one of the rates of increase was significantly different from zero and none of the regression analyses was associated with homogenous variances (Table 10). A power analysis indicated that these results were expected given the small sample size. Estimated rates of increase varied widely, from 0.020 to 0.151 depending on the sector or period, and were associated with large standard errors (up to 0.115; Table 10). The signs of the rates of increase were uniform among the different analyses and were all positive, although some rates were near to null or included negative values in their confidence intervals.

Gulf of St. Lawrence

In the Gulf of St. Lawrence, the distribution of harbour seals was also non-uniform. Except for one or two harbour seals observed at Baie de Moisie, near Tracadie, and east of Natashquan, this species was essentially concentrated around Anticosti and Prince Edward Island, and to a lesser extent near Gaspé, in the Mingan Archipelago, and at the Îles-de-la-

Madeleine (Table 2; Figure 5; Appendix II.2.1). Although these observations came from only one survey, it appears that harbour seals selected specific sectors within these areas of concentration. Harbour seals were abundant along the south of Anticosti Island, to the northeast of the Îles-de-la-Madeleine near Grande-Entrée, north of Percé / Île Bonaventure, east of Cloridorme along the Gaspé Peninsula, and between Hillborough Bay off Charlottetown and Rollo Bay on the east side of Prince Edward Island. Harbour seals were most numerous around Prince Edward Island (PEI) (N = 423) followed by Anticosti Island (N = 308) and the Gaspé Peninsula (N = 115 or 125–155 if counts provided for Île Bonaventure and Île Plate are included) (Table 11).

Harbour seals were found at 62 sites in the Gulf, including 10 sites along the Gaspé Peninsula, 1 at the Îles-de-la-Madeleine, 30 on Anticosti Island, 8 along the north shore, and 13 on PEI (Appendix II.2.2). These sites were grouped into 22 zones (Table 5; Figure 5). The zones of highest abundance included, in decreasing order of importance, Hillsborough Bay (PEI) (N = 206 ind.), Murray Head area (PEI) (N = 193 ind.), Forillon (Gaspé Peninsula) (N = 98 ind.), Pointe-Bilodeau to Pointe-Sud (Anticosti) (N = 78 ind.), Cap Tunnel (Anticosti) (N = 62 ind.), and Pointe-Sud-Ouest to Cap des Caps (Anticosti) (N = 57 ind.) (Table 5).

GREY SEAL

St. Lawrence Estuary

The extremes of the distribution of grey seals to the east and west in the St. Lawrence Estuary were similar to distributions of harbour seals, extending to Godbout and Batture aux Loups Marins, respectively. However, grey seals were distributed non-uniformly among the different sectors of the Estuary (Figures 4, 12, and 13). Their distribution to the east along the south shore was limited to Pointe Mitis, whereas to the west it was confined along the north shore to the Lower Estuary and east of Saint-Paul-du-Nord. In contrast to harbour seals, grey seals made little or no use of the Saguenay River; no grey seals were observed in this sector during any of the surveys. In June, the eastern limit of the distribution of grey seals was Baie-Comeau on the north shore and Bic on the south shore. To the west, their distribution was limited to Île aux Fraises / Les Pélerins along the south shore, with no sightings west of Betsiamites along the north shore of the Lower Estuary. Grey seals were distributed more extensively in August, from Godbout / Pointe Mitis in the east to Battures aux Loups Marins in the west, with some concentrations along the north shore west of Pointe-à-Boisvert (Figures 12 and 13).

Except in 1994 when the north shore was flown against the tide and when grey seal numbers might have been underestimated in the Lower Estuary, grey seals were consistently more numerous in the Lower Estuary than in the Upper Estuary, regardless of whether surveys were flown in June or August (G test of independence, $df = 2$, all $P < 0.001$; Table 7; Figure 14). Depending on survey year and season, and excluding the 1994 survey, 78–92% of the grey seals were observed in the Lower Estuary. The relative distribution of grey seals between the north and south shores was largely dependent on the size of the aggregations that were observed in the sector of Betsiamites / Pointe Saint-Gilles along the north shore of the Lower Estuary. These

aggregations were often large and highly variable in size between surveys (ca. 125–525 ind.) and appeared unaffected by season (Tables 4 and 7). As a result, grey seal numbers were similar between the south and north shore during 3 surveys (46–49%) and were larger along the south shore (including the mid-Estuary islands) during 3 other surveys (61–78%).

Grey seals were sighted at 43 sites grouped into 22 zones. Thirty-one and 12 sites were located along the south and north shore, respectively, whereas 13 and 30 sites were located in the Upper and Lower Estuary, respectively (Table 4; Figure 4; Appendix III.1.2). The larger aggregations were observed, in decreasing order of abundance, at Batture aux Outardes ($\bar{x}$ = 100.9; range = 0–292 ind.), Betsiamites River mouth ($\bar{x}$ = 75.0; range = 0–275 ind.), Bic archipelago ($\bar{x}$ = 65.0; range = 24–148 ind.), Bay of Pointe Saint-Gilles ($\bar{x}$ = 60.7; range = 0–232 ind.), Île aux Fraises ($\bar{x}$ = 46.0; range = 0–110 ind.), and Île Rouge ($\bar{x}$ = 26.7; range = 0–134 ind.) (Table 12). The Bic archipelago was the only site where seals were consistently observed during each survey, although grey seals were regularly present at Île Blanche, Île aux Fraises, Batture aux Outardes, Pointe Mitis, Îles de Kamouraska, and Pointe Saint-Gilles (Table 4; Table 13).

As with harbour seals, grey seals were consistently more numerous in August than in June, except during the 1994 survey when the north shore was flown against the tide (Table 1). Using surveys conducted during June and August of the same year (i.e., 1995 and 1996), this trend persisted even when considering each sector separately (i.e., Lower vs Upper Estuary, north vs south shore) (Table 7). The zones of highest concentration and regular occupancy were generally similar in June and August (Tables 12 and 13). Grey seals were present at a fewer number of sites and zones in June (N = 14 sites in 10 zones) than August (N = 37 sites in 19 zones) (Table 4; Figures 12 and 13). However, some zones were used exclusively in June (Razade d'en Bas, Batture de l'Île Ronde, and Île aux Lièvres), whereas several others were used only in August (including 8 zones in the Lower Estuary and 4 zones in the Upper Estuary) (Table 4).

General trends in the abundance of grey seals in the Estuary between 1994 and 2000 were contradictory between June and August (Table 10; Figure 15). Excluding from the analyses the total estimate from August 1994 as well as those obtained during this survey for the north shore and the Lower Estuary for the same reasons as those evoked for harbour seals, the June abundance of grey seals appeared to increase, although not significantly, between 1995 and 2000. However, grey seal abundance decreased significantly in August between 1994 and 1997 (Table 10; Figure 15). Like the harbour seal analyses, regression models detected no significant trends (Table 10). Estimated rates of increase for June 1995–2000 suggested an overall increase in grey seal abundance but a change in distribution towards a greater use of the Upper Estuary and the north shore. The negative rates of increase during August essentially resulted from a decrease in grey seal numbers in the Lower Estuary and along the north shore, with little counterbalancing changes in numbers observed in the Upper Estuary and along the south shore (Tables 4 and 10).

Gulf of St. Lawrence

The distribution of grey seals in the Gulf of St. Lawrence was somewhat similar to that of harbour seals (Figure 6; Appendix III.2.1). The presence of grey seals along the north shore was restricted to the Mingan Archipelago, all around Anticosti Island between Île aux Perroquets and Pashashibou, in the Baie de Gaspé, at the Îles-de-la-Madeleine, and Prince Edward Island. Reports from partners also indicated their presence at Île Plate and Île Bonaventure at the tip of the Gaspé Peninsula, and in the Kouchibouguac Park along the shore of New Brunswick (Table 2). In contrast to harbour seals, who mostly used the south coast of Anticosti Island, grey seals formed large aggregations all around the island. However, grey seals made no use of the Îles-de-la-Madeleine, but rather aggregated on islands several kilometres away, i.e., Île de Corps Mort, Île Brion, and Rocher aux Oiseaux. Their distribution at Prince Edward Island was also less extensive than for harbour seals, essentially restricted to Hillsborough Bay off Charlottetown. Anticosti Island constituted the main area of concentration of grey seals in the Gulf of St. Lawrence (N = 2110), followed by the Îles-de-la-Madeleine (N = 151), Mingan Archipelago (N = 111), Prince Edward Island (N = 80), Kouchibouguac Park (N = 55), and the Gaspé Peninsula (N = 22–47) (Table 11; Appendix III.2.1).

Grey seals were sighted at 47 different sites grouped into 20 zones. Of these sites, 4 were located in the southwestern Gulf, 3 at the Îles-de-la-Madeleine, 27 at Anticosti Island, 8 along the north shore, and 5 at Prince Edward Island (Figure 6; Appendix III.2.2). The zones of highest abundance were mostly located around Anticosti Island and included, in decreasing order of importance, Baie Natiscotec to Pointe Guy (Anticosti) (N= 704), Pointe des Morts to Pointe Dauphiné (Anticosti) (N= 551), Pointe de l'Est to Cap aux Goélands (Anticosti) (N= 505), Baie Ellis (Anticosti) (N= 250), Mingan Islands (Mingan Archipelago) (N = 109), Île Brion (Îles-de-la-Madeleine) (N = 100), and Hillsborough Bay (PEI) (N = 70) (Table 6).

HAUL-OUT SUBSTRATES

Harbour and grey seals were observed hauled-out on a variety of substrates such as isolated rocks, exposed reefs, sand banks, and reefs connected to land (Appendices II.1.2, II.2.2, III.1.2 and III.2.2). Both species were also seen on rocky ledges located on the shore and backed by a steep cliff. This situation was observed regularly at Anticosti Island and in the Saguenay River (harbour seals only).

Of the 95 sites used by harbour seals in the Estuary, 56 (59%) were composed of isolated rocks, 18 (19%) of exposed reefs, 10 (11%) of cliffs, 5 (5%) of sand banks, and the remaining of a mix of isolated rocks and exposed reefs (4%), of cliffs and isolated rocks (1%), or of exposed reefs, isolated rocks, and sand banks (1%) (Appendix II.1.2). This tendency was maintained when substrate use was examined in terms of seal abundance, with a majority of harbour seals (50%) hauling-out on isolated rocks and 45% using exposed reefs.

Among grey seals, substrate uses were different depending on whether or not they were weighted for the number of individuals observed at each site. Substrates where grey seals were most commonly observed in the Estuary were exposed reefs (19 or 44% of haul-out sites), followed by isolated rocks (16 or 37% of haul-out sites) and sand banks (6 or 14% of haul-out

sites). However, sand banks, with 56% of the grey seals, were the preferred substrate when uses were weighted for seal abundance, followed by exposed reefs (33%) and isolated rocks (11%) (Appendix III.1.2). This difference reflects essentially the larger carrying capacity of sand banks compared to reefs or isolated rocks.

The collection of information on haul-out substrate was not as systematic in the Gulf of St. Lawrence, which prevents a rigorous analysis of haul-out substrate uses in this area.

HUMAN ACTIVITIES

Human activities were observed during each of the aerial surveys except in the Estuary in June 1996 (Table 14). In the Estuary, the majority of the events (N = 35) occurred in August (89%) in the Saguenay River (69%), usually kayaking (63%). The remaining activities involved small crafts (11%), jet skis (6%), fishing vessels (11%), and people walking on the shore (11%). During the Gulf surveys, the great majority (83%) of the human activities were observed around Prince Edward Island (Table 15). The presence of boats was the most frequent type of potential disturbance (38%), followed by people walking on the shore or in the water (38%), aquaculture (12%), and commercial shipping (4%).

DISCUSSION

Pinniped abundance surveys are usually conducted at sites or at times of the year when a large proportion of the animals is likely to be observed. Pinnipeds spend more time hauled out (either on land or ice) during lactation and the annual moult (e.g., Worthy et al. 1992; Olesiuk 1999) because of the need for a solid substrate for these two activities (Ling 1970; Bonner 1984; Ashwell-Erickson et al. 1986; Oftedal et al. 1987; Boily 1995). Often, counts of pups are used because this component of the population remains hauled out throughout the lactation period, which occurs on traditional rookeries or whelping patches (e.g., Westlake et al. 1997; Hammill et al. 1998; Galimberti and Sanvito 2001). A population model is then used to estimate total population size by combining pup production numbers with information on age-specific reproductive rates and known removals (Mohn and Bowen 1996). Surveys of harbour seals have been conducted during both the breeding and moulting periods (e.g., Everitt and Braham 1980; Olesiuk et al. 1990; Thompson and Harwood 1990; Stobo and Fowler 1994; Huber et al. 2001; Boveng et al. 2003; Small et al. 2003; Ver Hoef and Frost 2003). However, pup survey methods are not feasible with harbour seals because well-defined concentrations of pups rarely occur and because the pups often accompany the females in the water soon after birth (Lawson and Renouf 1985). The alternative to a pup survey for this species is to count total numbers of seals at haul-out sites.

Harbour seals pose an additional challenge because they often occur in coastal areas, where they are easily disturbed by human activity. Motorized boats, kayaks and canoes, barking dogs, and people walking on beaches have been identified repeatedly as important sources of disturbance of seals at haul-out sites (Renouf et al. 1981; Schneider and Payne 1983; Terhune and Almon 1983; Allen et al. 1984; Suryan and Harvey 1999; Henry and Hammill 2001; Nordstrom 2002). In this study, potentially disturbing human activities were observed in several

instances, particularly during August surveys of the Saguenay River and around Prince Edward Island (Table 8). However, several of the most important haul-out sites for harbour seals and grey seals in the St. Lawrence Estuary are either islands or shoals that are difficult to reach on foot or by boat. Examples of remote haul-out sites include Batture aux Alouettes, Île Blanche, Hauts-fonds de Mille-Vaches, Île Rouge, Batture de Tobin, Batture de l'Île Ronde, Batture aux Loups Marins, and Île aux Coudres. Other major sites such as Pointe Mitis, Bic Island and associated reefs, sand banks in the eastern portion of the north shore, and the Saguenay River haul-out sites are more easily accessible. However, it is unlikely that disturbance occurred during the surveys at Pointe Mitis and Bic or at the sand banks along the north shore because 1) sites in the eastern portion of the Estuary were surveyed in early morning, 2) Pointe Mitis was monitored by an independent team of observers that confirmed that no disturbance had occurred that morning (V. Lesage and M.O. Hammill, unpublished data), and 3) the exit from Bic harbour is limited around low tide. In contrast, counts in the Saguenay River might have been reduced by boat traffic, although it is difficult to evaluate the probability of such events or the extent of their effects on counts in the context of the present study. In the Gulf of St. Lawrence, most human activities were concentrated around Prince Edward Island. How these activities affected seal counts on haul-out sites is uncertain, since we have no previous knowledge of the distribution of important haul-out sites around the island, limiting our capacity to detect potential disturbance events.

During the survey, grey seals near haul-out sites were seen in the water more often than were harbour seals. Grey seals also entered the water regularly when surveyed from 500 ft whereas harbour seals rarely did so during overflights of their haul-out sites. Few grey seals hauled-out near shore compared to offshore reefs, which also supports the hypothesis that they are more sensitive to human activity than harbour seals.

The period chosen for the June surveys (15–21 June) in the Estuary corresponded to mid to late lactation of harbour seals in that area, when 95% of the females have given birth and < 5% of the pups have been weaned (Dubé et al. 2003). During this period, adult females are more strongly dependent on land (Venables and Venables 1955; Newby 1973; Lawson and Renouf 1985) while other segments of the population are not and are likely present in lower numbers compared to lactating females and pups (e.g., Härkönen et al. 1999; Olesiuk 1999; Huber et al. 2001). The August surveys clearly overlapped with the moult, which begins in the Estuary at the end of July in juveniles and extends into September in adults, particularly males (V. Lesage and M.O. Hammill, unpublished data). During the moult, all segments of the population except newborn pups have an increased need to haul-out to stimulate the moult, a requirement that might explain the larger numbers of seals counted at haul-out sites during that period compared with the pupping season (Brown and Mate 1983; Thompson et al. 1989; Walker and Bowen 1993; Frost et al. 1999; Härkönen et al. 1999; Huber et al. 2001; Jemison and Kelly 2001; this study). However, the representation of the different segments of the population on haul-out sites at the time of the surveys is uncertain, given the asynchrony of the moult among the different segments of the population (Ashwell-Erickson et al. 1986; Thompson and Rothery 1987; Härkönen et al. 1999; Huber et al. 2001; Daniel et al. 2003; Simpkins et al. 2003).

In this study, surveys were flown within a four-hour window around mid-morning low tides of similar amplitude and in similar weather conditions to minimize the effects of these

factors on counts. Tide strongly influences the haul-out behaviour of harbour seals in the St. Lawrence Estuary (Lesage 1999). Its effect was not evaluated in the Gulf of St. Lawrence but was probably less important, particularly in its southern portion, given the smaller amplitudes of tides. Preliminary analyses of the influence of tidal height on harbour seal haul-out behaviour in the St. Lawrence Estuary (at Pointe Mitis) using radio-telemetry indicate that approximately 70% of the seals that are hauled-out at low tide might be present 2 h before or after low tide (V. Lesage and M.O. Hammill, unpublished data). These results are similar to observations elsewhere (e.g., Thompson et al. 1997; Frost et al. 1999; Olesiuk 1999; Boveng et al. 2003; Simpkins et al. 2003; Small et al. 2003; Ver Hoef and Frost 2003); they indicate that even counts obtained within the 4-h window around low tide require standardization for survey counts to be fully comparable. In August 1994, the 4-h window was not respected during flights of the most easterly portion of the north shore of the Estuary and the Saguenay River (Appendix I). Fewer harbour seals (n = 61) and grey seals (n = 3) were observed in these sectors compared with August counts from any of the subsequent years (Table 3: zones 31–35 for harbour seals; Table 4: zones 19–22 for grey seals). Major haul-out sites in the eastern portion of the north shore were mostly sand banks and were available only at low tide. These sites included Batture aux Outardes, Pointe Saint-Gilles (both species), and the Betsiamites River mouth (grey seals only). Consequently, index estimates of harbour and grey seal abundance in August 1994 were more negatively biased than the other surveys.

Counts of hauled-out animals are still only indices of abundance because not all animals in the population haul-out at the same time (Pitcher and McAllister 1981; Thompson et al. 1997; Härkönen et al. 1999; Olesiuk 1999; Huber et al. 2001; Simpkins et al. 2003). Factors such as time of day, tidal state, weather conditions, disturbance, and behaviour of individual seals affect haul-out activity (Pitcher and McAllister 1981; Schneider and Payne 1983; Krieber and Barrette 1984; Yochem et al. 1987; Thompson et al. 1989; Thompson and Miller 1990; Watts 1993; 1996; Mathews and Kelly 1996; Frost et al. 1999; Watts 1996; Bowen et al. 2001b; Henry and Hammill 2001; Huber et al. 2001; Boveng et al. 2003; Small et al. 2003; Simpkins et al. 2003; Ver Hoef and Frost 2003). Factors to adjust survey counts for animals in the water at the time surveys were flown have been developed and applied in some studies using radio-telemetry or time-depth recorders (Pitcher and McAllister 1981; Harvey 1987; Yochem et al. 1987; Thompson et al. 1989; Thompson and Harwood 1990; Thompson et al. 1997; Olesiuk 1999; Huber et al. 2001; Boveng et al. 2003; Simpkins et al. 2003; Small et al. 2003), observations of recognizable individuals (Sullivan 1982; Härkönen et al. 1999), or other approaches (Olesiuk et al. 1990). Proportions of harbour seals ashore at peak haul-out times during the pupping or moulting seasons vary between 0.41 and 0.835 depending on seasons, areas, and environmental conditions, corresponding to correction factors of 1.198 to 2.44 (Pitcher and McAllister 1981; Stewart and Yochem 1983; Thompson and Harwood 1990; Withrow and Loughlin 1995; 1996; Thompson et al. 1997; Olesiuk 1999; Simpkins et al. 2003). However, several of these correction factors were obtained using small sample sizes or were biased towards a particular sex or age class (reviewed in Huber et al. 2001). Reasonable sample sizes to adequately describe haul-out patterns and develop correction factors are available from two studies conducted during the pupping season (Olesiuk 1999: N = 34; Huber et al. 2001: N = 124) and four studies conducted during the moult (Simpkins et al. 2003: N = 68; Withrow and Loughlin 1995; 1996;

1997: N = 36, 29 and 28, respectively). All of these correction factors were developed for surveys conducted in areas where tide represents the main factor affecting the haul-out behaviour of harbour seals.

As indicated previously, the haul-out behaviour of harbour seals in the St. Lawrence Estuary is controlled principally by tides (Lesage 1999). This is also probably the case in the northern Gulf of St. Lawrence, although no data exists for this area. In the southwestern Gulf of St. Lawrence and the Îles-de-la-Madeleine, the tidal amplitude is small. In these areas, it is likely that time of the day is a more important factor than tide for the haul-out behaviour of harbour seals, although there is no information available for these areas either. In the latter areas, the use of a correction factor developed for regions where tide is not the main influential factor on haul-out behaviour might be more judicious. However, no such factor exists in the literature for the pupping season, the period when the Gulf of St. Lawrence was surveyed. Therefore, June (pupping) counts in our study were adjusted using correction factors developed with sufficient sample sizes for the pupping season, and for areas where tide was the main factor influencing the haul-out behaviour. Specifically, June counts were corrected using information presented in Huber et al. (2001) only (correction factors: range 1.36–1.62; mean = 1.53) because data used by these authors were collected exclusively during pupping in various regions of Washington and Oregon, whereas data included several weeks prior to pupping in Olesiuk (1999). It is suspected that in areas where tides are of lesser amplitudes, the haul-out patterns of harbour seals may not be as synchronous (e.g., Boulva and McLaren 1979). If this were the case, then applying correction factors from areas where haul-out behaviour is driven by tides would underestimate the number of seals in areas where haul-out was affected by time of day. In our study, this bias would lead to an underestimation of harbour seal abundance in the southwestern Gulf of St. Lawrence and the Îles-de-la-Madeleine. Moult surveys were conducted exclusively in the Estuary and thus were corrected using the correction factors developed for this period and for areas influenced by tides. Correction factors for moult surveys vary between studies. Simpkins et al. (2003) obtained correction factors of 1.23 and 1.53, which represented the corrections obtained under the best conditions encountered during any surveys of their two study sites. Withrow and Loughlin (1995; 1996; 1997) obtained correction factors varying between 1.50 and 1.90 for two sites available mostly at low tide in Alaska. The range of values, i.e., 1.23–1.90, was used to correct the August surveys. Applying these correction factors to the most recent June and August counts in the Estuary resulted in absolute abundance estimates of 811–1252 harbour seals in 1997 (August) and 721–858 animals in 2000 (June). The use of the same correction factor for the June surveys of the Gulf of St. Lawrence resulted in estimates of 635–757 harbour seals for areas of the Gulf covered in 1996 and 575–685 individuals for Prince Edward Island in 2001. Combining these two counts with the caveat that the surveys in these two complementary areas were conducted five years apart, and adding to them the 40 harbour seals observed at Île Plate in 1996 (Table 2), resulted in an estimate of 1250–1482 harbour seals for the surveyed area of the Gulf of St. Lawrence.

Unfortunately, we were unable to cover the eastern and northeastern portions of the Gulf of St. Lawrence during our surveys. However, there is some historical evidence that harbour seals do occur in these areas (Lavigne 1978; Boulva and McLaren 1979). To obtain some idea of the possible abundance for all of the Gulf of St. Lawrence, we estimated the density of seals per

kilometre flown and extrapolated this density to the portion of the Gulf not flown during the surveys (Tables 1 and 2). This resulted in a density estimate of 0.38–0.45 seals/km in the Estuary in June 2000 (corrected for seals in the water) and 0.23–0.28 seals/km in the Gulf (uncorrected for seals in the water) when the 1996 and 2001 surveys were combined. The extrapolation of the latter density estimate to the unsurveyed area of the Gulf (i.e., 8080 km) resulted in 1858–2262 unsurveyed harbour seals in the Gulf, or a total of 3108–3744 harbour seals for the entire Gulf of St. Lawrence. Taking the average of the Estuary counts and including the Gulf estimates resulted in an abundance index of 4000 to 5000 (rounded to the nearest 1000) harbour seals in the Estuary and Gulf of St. Lawrence.

Very little information exists concerning the historical abundance and distribution of harbour seals in the Estuary and Gulf of St. Lawrence. Using questionnaires to fisheries officers, bounty kill data, or personal interviews with fishermen in different areas of Quebec, New Brunswick, Nova Scotia, and Prince Edward Island, Boulva and McLaren (1979) estimated a total population of 12,700 harbour seals in eastern Canada in 1973, of which approximately 4700 were from the Estuary (N = 710) and the Gulf of St. Lawrence (N = 4000), as defined in our study (Figure 2). It is unclear whether harbour seals around Anticosti Island, which are noted as "numerous" in Boulva and McLaren (1979: their Figure 1), contributed to their population size estimate. There was also no information available for the north shore east of the Mingan Islands, where harbour seals most probably occurred in the 1970s (Lavigne 1978). Harbour seal numbers were thought to be declining in most regions in 1973 and were at best stable in a few areas (Boulva and McLaren 1979). A similar study conducted in 1978 was based on interviews of at least two hunters in each community along Quebec's north shore between Petite-Rivière-Saint-François (near Baie-Saint-Paul in the St. Lawrence Estuary) and Blanc Sablon (Lower North Shore), in addition to four fisheries district representatives (Ministère de l'Industrie et du Commerce du Québec), seal skin buyers, and lighthouse keepers (Lavigne 1978). The author estimated from these interviews that 405 harbour seals used the region equivalent to our survey area in the St. Lawrence Estuary, i.e., the region located between Batture aux Loups Marins and Pointe-des-Monts / Ste-Anne-des-Monts (Figure 16). Lavigne (1978) also provided estimates for different sectors of the northern Gulf of St. Lawrence, including the Gaspé Peninsula (N = 70), Anticosti Island (N = 1130), north shore west of Natashquan (N = 317), and Natashquan east to Blanc Sablon (N = 546), for a total of 2468 individuals. While trends in numbers in the St. Lawrence Estuary varied depending on sectors from increasing to stable or decreasing, they were considered as generally declining in all parts of the northern Gulf of St. Lawrence except the Gaspé Peninsula, where harbour seal numbers were considered stable (Figure 16).

Malouf (1986) suggested that the harbour seal population in eastern Canada declined at an annual rate of 4% between the 1940s and 1973, largely as a result of a bounty kill that took place between 1927 and 1975 (see also Lavigne 1978). The questionnaire/interview survey of 1973 indicated that harbour seal numbers in the St. Lawrence Estuary were stable or declining, depending on the colony (Boulva and McLaren 1979), whereas the study conducted five years later using a similar approach indicated similar trends in some areas of the Estuary but increasing numbers at Hauts-fonds de Mille-Vaches and along the south shore (Lavigne 1978). The abundance estimates obtained in these two studies, assuming they were directly comparable, would indicate a 43% decline from 705 to 405 harbour seals between 1973 and 1978, a trend that

might be consistent with the continued bounty kill until 1975 and the continued harvest until 1979.

Owing to differences in methodologies, it is unclear how the numbers reported in the early studies (Lavigne 1978; Boulva and McLaren 1979) compare with our haul-out counts obtained via aerial surveys. Questionnaires and perceptions tend to produce under-estimates of unknown bias (Caughley 1977). Aerial surveys also under-estimate abundance because not all animals are hauled-out when the aircraft passes overhead. The trend in the abundance of harbour seals in the Estuary since 1994 is also unclear, owing to the small number of surveys available for these analyses. Growth rates varied widely depending on sectors or sites and were in some cases larger than the maximum growth rate of 12–13% estimated for pinniped populations not subjected to immigration or to constraints on reproductive life history typical of harbour seals (Barlow et al. 1995). Several growth rates approached zero or encompassed zero or negative values in their 95% confidence interval, indicating that a slow or a negative growth rate is also plausible (Table 10). A longer time series of standardized aerial surveys is needed to clarify these trends. An interpretation of the results from the Gulf of St. Lawrence in the context of earlier studies (Lavigne 1978; Boulva and McLaren 1979) was even more difficult, given that neither of the two earlier studies nor our aerial surveys covered the entire Gulf of St. Lawrence.

It is difficult to examine our results in a larger perspective given the uncertainty related to the degree of separation of the harbour seal colonies in Atlantic Canada and the eastern USA as well as the fragmentary nature of long-term data on harbour seal abundance for most areas of the Northwest Atlantic. Harbour seals that are found along the eastern USA and Canadian coasts are currently considered as one population (Temte et al. 1991). However, in other regions, significant genetic differentiation has been documented among harbour seal colonies located only a few hundred kilometres apart (Stanley et al. 1996; Goodman 1998; Härkönen and Harding 2001; Westlake and O'Corry-Crowe 2002). Satellite and VHF radio telemetry and analyses of contaminant profiles of harbour seals from different colonies of the Estuary and Gulf of St. Lawrence would also suggest some site fidelity and separation between colonies in these regions (Lesage 1999; Lebeuf et al. 2003; Lesage et al. 2004). Long-term data on abundance exist for only two areas in eastern Canada and the eastern USA; they indicate a sharp decline in the abundance of harbour seals during the 1990s at Sable Island (Lucas and Stobo 2000; Bowen et al. 2003a), and generally increasing numbers of harbour seals during the same period in Maine and southern New England (Waring et al. 2003; Gilbert et al. 2005). Mortality through predation, competition for haul-out space, food abundance, and availability through competition are among the factors that might affect survival or the degree of emigration or immigration (e.g., Bowen et al. 2003a).

Grey seals and harbour seals are sympatric in distribution in several areas of the North Atlantic, including eastern Canada (e.g., Mansfield 1967b; Stobo and Fowler 1994; Thompson et al. 1996; Bjørge et al. 2002; Bowen et al. 2003a). The historical population trends of grey seals in the Northwest Atlantic are poorly known. However, grey seals were known to be rare in the Estuary and Gulf of St. Lawrence during the late 1800s and were not actively hunted (Comeau 1945). They were hunted for a bounty in eastern Canada during the 1900s, which contributed to reducing grey seal numbers to only a few thousand individuals by the early 1960s (Mansfield and Beck 1977; Zwanenburg and Bowen 1990). Interviews with hunters, fisheries district

representatives, seal skin buyers, and lighthouse keepers suggested that grey seals numbered 600 and 4830 individuals in the Estuary and northern Gulf of St. Lawrence, respectively, in 1978 (Lavigne 1978; Figure 17). It is uncertain how these numbers compare with our uncorrected estimates of 111–723 and 2554 grey seals for these two areas in 1994–2001. Grey seal abundance is usually determined through pup counts on the ice or land during the pupping season (e.g., Haug et al. 1994; Hammill et al. 1998; Bowen et al. 2003b). Consequently, no correction factors equivalent to those developed for harbour seals are available for this species. The monitoring of grey seal pup production at Sable Island, now the largest grey seal colony in the world, and in the Gulf of St. Lawrence indicate a continued increase of this population over the last three decades (Hammill et al. 1998; Bowen et al. 2003b). During the short time series of this study, more grey seals were observed at haul-out sites during August than in June. However, grey seal numbers increased during June from 1995 to 2000, while they decreased during August from 1995 to 1997 (n.b.: the August survey in 1994 was excluded from the trend analysis since the north shore was flown against the tide) (Appendix I). Annual rates of increase or decrease in the Estuary far exceeded the maximum potential rates of increase of 12–13% in several instances, reflecting the unpredictable nature of the grey seal population summering in the Estuary and northern Gulf of St. Lawrence (Goulet et al. 2001).

During our surveys, harbour and grey seals were often observed in the same area, which indicates potential sharing of haul-out space or food resources or competition if these resources are limited. On occasion, harbour seals and juvenile grey seals were observed hauled-out in the same group in the Estuary; however, haul-out sites were usually monopolized by one species or the other. Aggressive confrontations between the two species have been observed in the Estuary and suggest the existence of a form of competitive exclusion (V. Lesage, pers. obs.). This might be the case for Île Blanche and Île aux Fraises, where fewer grey seals and harbour seals, respectively, are observed in August compared to June. At Sable Island, where grey seal pup production has increased exponentially over the last four decades, there are concerns about a reduction in food availability for harbour seals due to competition with the increasing number of grey seals (Bowen et al. 2003a). The diet of harbour seals in the Estuary and Gulf of St. Lawrence is poorly known and may overlap to some extent with the diet of grey seals (Hammill and Stenson 2000; Lesage et al. 2001). Satellite telemetry data from adult harbour seals and subadult grey seals in the Estuary indicated that subadult grey seals consistently dove to deeper depths than the harbour seals while at sea (Lesage et al. 1995), suggesting a spatial partitioning of foraging areas in the 3-dimensional space. Although these results are suggestive of some degree of partitioning of food resources between the two species, they are insufficient to reject the possibility of a significant dietary overlap between the two species.

This study represents the first attempt to estimate the abundance and distribution of harbour seals in the Estuary and Gulf of St. Lawrence using aerial surveys. There remains considerable uncertainty over the current status of harbour seals in these areas. A continued monitoring of harbour seal abundance coupled with a better understanding of their diet would help clarify the effects that changes to the ecosystems, including the abundance of potential competitors, might have on harbour seals (Bowen et al. 2003a; Savenkoff et al. 2004). Although the August surveys provided higher counts of harbour seals, we suggest that surveys be flown in June because it is easier to attach telemetry devices in the spring to obtain information on haul-

out behaviour. In addition, counts obtained during the moult might be more affected by slight between-year differences in the timing of surveys, given the asynchronous nature of the moult among harbours seals of different age classes and sexes (Härkönen et al. 1999; Simpkins et al. 2003). Surveys conducted in June would also be flown before the busy summer vacation period when haul out sites are more likely to be disturbed (Henry and Hammill 2001).

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Table 1. Total number of harbour seals and grey seals observed in the St. Lawrence Estuary and Saguenay River during aerial surveys in 1994–1997 and 2000. Detailed distributions of the two species during each survey are presented in Appendices II.1.1 and III.1.1.

Survey period	Dates	Year	Species			Coastline distance[a] (km)
			Harbour seal	Grey seal	Unidentified	
June	15–18	1995	410	268	5	1898[b]
	18–20	1996	467	244	1	1908
	19–21	2000	530	354	0	1908
August	22, 23, 26	1994	389[c]	111[c]	1[c]	1630[d]
	13–15	1995	578	723	3	1908
	15, 17, 19	1996	627	675	2	1908
	20, 21, 24	1997	659	558	0	1908

[a] Distance calculated from a digital 1:250,000 scale map using a Mercator projection
[b] The area of Saint-Fulgence in the Saguenay River was not surveyed due to fog
[c] The north shore was surveyed from east to west
[d] The eastern limit of the study area was Métis-sur-Mer / Baie-Comeau in 1994

Table 2. Total number of harbour seals and grey seals observed in the Gulf of St. Lawrence during surveys in June 1996 and 2001. Observations reported in two areas where surveys were not possible due to restrictions over bird sanctuaries (Kouchibouguac Park and Percé / Île Bonaventure) are also presented. Detailed distributions of the two species during each survey are presented in Appendices II.2.1 and III.2.1.

Method	Dates	Year	Species			Coastline distance[a] (km) or area covered
			Harbour seal	Grey seal	Unid.	
Aerial survey						
	15–17, 21–23	1996	467	2394	36	5355
	12–13	2001	423	80	0	1275
Vessel-based survey						
	15	1996	0	55[b]	0	Kouchibouguac[b]
	9	1996	40[c]	0	0	Île Plate
	10	1996	10[c]	0	0	Île Plate
	12	1996	0	25+[d]	0	Île Plate
	14	1996	0	20[e]	0	Île Plate
	12	1996	0[d]	0	0	S of Î. Bonaventure (bird sanctuary)
	16	1996	0	6	0	S of Î. Bonaventure (bird sanctuary)

[a] Distance calculated from a numerical 1:250,000 scale map using a mercator projection
[b] Survey time was not noted
[c] Survey conducted 1–2 h before high tide
[d] Survey conducted 30 min before low tide
[e] Survey conducted 2h45 after low tide

Table 3. Number of harbour seals observed in different zones of the St. Lawrence Estuary and Saguenay River during aerial surveys in 1994–2000. "Zone ID" refers to zones presented in Figure 3. The location of haul-out sites within each zone and the number of seal observations at each site are presented for each survey in Appendices II.1.2 and II.1.3.

Map ID	Zone ID	Zone name	June			August				Range	Mean abundance
			1995	1996	2000	1994	1995	1996	1997		
1	1	Matane	0	0	1	0	0	0	0	0–1	0.1
1	2	Saint-Ulric	0	1	0	0	7	1	6	0–7	2.1
2	3	Pointe Mitis	59	63	71	46	55	60	60	46–71	59.1
2	4	Baie Mitis	0	6	4	1	1	7	13	0–13	4.6
3	5	Sainte-Luce	0	0	0	0	2	2	2	0–2	0.9
4	6	Pointe-au-Père	0	1	2	0	0	0	0	0–2	0.4
5	7	Rimouski	5	0	4	8	8	8	6	0–8	5.6
6-7	8	Bic archipelago	109	105	128	72	105	77	90	72–128	98.0
6	9	Anse à Mercier	2	0	0	0	0	0	0	0–2	0.3
8	10	Anse des Riou	16	8	2	3	0	3	2	0–16	4.9
8	11	Île aux Basques	4	1	1	0	0	0	0	0–4	0.9
8	12	Île aux Pommes	5	2	0	0	0	0	0	0–5	1.0
8	13	Batture de Tobin and de l'Île Ronde	13	27	38	22	46	39	37	13–46	31.7
9	14	Île Verte	5	7	1	24	13	35	36	1–36	17.3
9	15	Île Rouge	1	0	0	1	0	0	0	0–1	0.3
10	16	Rocher Percé	1	0	0	3	0	0	0	0–3	0.6
10	17	Île Blanche	49	37	45	67	103	76	104	37–104	68.7
11	18	Île aux Lièvres	1	1	0	0	0	0	1	0–1	0.4
11	19	Île aux Fraises	26	20	15	1	5	5	5	1–26	11.0
11	20	Les Pélerins	7	0	4	0	1	4	0	0–7	2.3
12	21	Battures de Kamouraska	0	0	0	0	0	1	8	0–8	1.3
12	22	Anse Sainte-Anne	0	0	0	0	0	1	2	0–2	0.4
13	23	Battures aux Loups Marins	6	8	2	2	9	6	7	2–9	5.7
12	24	Île aux Coudres	0	0	0	1	0	0	3	0–3	0.6
12	25	Saint-Irénée	0	0	0	0	0	1	0	0–1	0.1
14	26	Baie des Rochers	1	1	0	0	0	2	0	0–2	0.6
15	27	Batture aux Alouettes	67	66	102	73	77	123	103	66–123	87.3
16	28	Batture à Théophile	0	0	0	0	0	1	0	0–1	0.1
17	29	Hauts-fonds de Mille-Vaches	13	31	43	41	46	65	54	13–65	41.9

Table 3. (Continued)

Map ID	Zone ID	Zone name	June			August				Range	Mean abundance
			1995	1996	2000	1994	1995	1996	1997		
18	30	Baie Laval	0	1	1	0	0	1	0	0–1	0.4
18	31	Battures aux Gibiers	1	2	1	1	10	15	9	1–15	5.6
19	32	Baie des Îlets Jérémie	0	28	38	0	30	21	0	0–38	16.7
220	33	Batture aux Outardes	17	49	12	19	27	28	59	12–59	30.1
21	34	Bay of Pointe Saint-Gilles	1	1	2	0	8	6	5	0–8	3.3
22	35	Pointe Rouge	0	0	0	0	1	0	2	0–2	0.4
23-24	36	Saguenay River mouth to L'Anse-Saint-Jean	0	0	2	0	4	1	7	0–7	2.0
25-26	37	L'Anse-Saint-Jean to Baie des Ha! Ha!	1	1	11	4	20	33	36	1–36	15.1
27	38	Baie des Ha! Ha! to Saint-Fulgence	0	0	0	0	0	5	2	0–5	1.0

Table 4. Number of grey seals observed in different zones of the St. Lawrence Estuary and Saguenay River during aerial surveys in 1994–2000. "Zone ID" refers to zones presented in Figure 4. The location of haul-out sites within each zone and the number of seal observations at each site are presented for each survey in Appendices III.1.2 and III.1.3.

Map ID	Zone ID	Zone name	June			August				Range	Mean abundance
			1995	1996	2000	1994	1995	1996	1997		
1	1	Pointe Mitis	0	0	0	2	6	7	5	0–7	2.9
1	2	Baie Mitis	0	0	0	0	0	1	0	0–1	0.1
2-3	3	Bic archipelago	41	24	42	45	117	148	38	24–148	65.0
4	4	Razade d'en Bas	68	0	2	0	0	0	0	0–68	10.0
5	5	Batture de l'Île Ronde	0	7	0	0	0	0	0	0–7	1.0
5	6	Île Verte	0	0	0	2	0	1	0	0–2	0.4
6	7	Rocher Percé	0	0	0	16	26	3	0	0–26	6.4
7	8	Batture de Rivière-du-Loup	0	0	0	1	0	0	0	0–1	0.1
5	9	Île Rouge	0	0	0	0	11	42	134	0–134	26.7
6	10	Île Blanche	4	10	0	2	9	26	14	0–26	9.3
7	11	Île aux Lièvres	0	52	0	0	0	0	0	0–52	7.4
7	12	Île aux Fraises	29	0	35	37	15	110	96	0–110	46.0
7	13	Les Pélerins	0	1	0	2	0	2	0	0–2	0.7
8	14	Îles de Kamouraska	0	0	0	1	1	1	7	0–7	1.4
9	15	Battures aux Loups Marins	0	0	0	0	7	0	5	0–7	1.7
10	16	Pointe à Boisvert	0	0	0	0	2	0	0	0–2	0.3
11	17	Battures aux Gibiers	0	0	0	0	1	10	3	0–10	2.0
12	18	Baie des Îlets Jérémie	0	0	0	0	0	1	0	0–1	0.1
12	19	Betsiamites River mouth	0	0	275	0	0	250	0	0–275	75.0
13	20	Batture aux Outardes	115	150	0	3	292	5	141	0–292	100.9
14	21	Bay of Pointe Saint-Gilles	11	0	0	0	232	68	114	0–232	60.7
15	22	Grande Baie Saint-Nicolas	0	0	0	0	4	0	1	0–4	0.7

Table 5. Number of harbour seals observed in different zones of the Gulf of St. Lawrence during aerial surveys in June 1996 and 2001. "Zone ID" refers to zones presented in Figure 5. Areas not surveyed are indicated by a dash. The location of haul-out sites within each zone and the number of seal observations at each site are presented in Appendix II.2.2.

Zone ID	Zone name	June	
		1996	2001
1	Cloridorme – Point à la Renommée	13	-
2	Forillon	98	-
3	Seal Cove – Pointe Verte	3	-
4	Tabusintac Bay	1	-
5	Hillsborough Bay	-	206
6	Big Point	-	5
7	Murray Head area	-	193
8	Rollo Bay	-	19
9	Grande Entrée	32	-
10	Baie Ellis	8	-
11	Cap à la Craie	41	-
12	Anse Kneeland – Baie Bonsecours	31	-
13	Pointe du Sud-Ouest – Cap des Caps	57	-
14	Pointe Bilodeau – Pointe du Sud	78	-
15	Baie de l'Outarde	8	-
16	Cap Tunnel	62	-
17	Baie Observation	10	-
18	Anse Hacket – Grande Baie Martin	9	-
19	Baie du Petit Makasti	4	-
20	Pashasibou	2	-
21	Mingan Islands	9	-
22	Baie de Moisie	1	-

Table 6. Number of grey seals observed in different zones of the Gulf of St. Lawrence during aerial surveys in June 1996 and 2001. "Zone ID" refers to zones presented in Figure 6. Areas not surveyed are indicated by a dash. The location of haul-out sites within each zone and the number of seal observations at each site are presented in Appendix III.2.2.

Zone ID	Zone name	June	
		1996	2001
1	Forillon	15	-
2	Seal Cove – Pointe Verte	7	-
3	Hillsborough Bay	-	70
4	Big Point	-	10
5	Île Le Corps-Mort	45	-
6	Île Brion	100	-
7	Rocher aux Oiseaux	6	-
8	Baie Ellis	250	-
9	Cap Sainte-Marie	2	-
10	Cap MacGilvray – Cap Ottawa	27	-
11	Pointe des Morts – Pointe Dauphiné	551	-
12	Pointe aux Oies – Pointe Heath	44	-
13	Pointe de l'Est – Cap aux Goélands	505	-
14	Baie Natiscotec – Pointe Guy	704	-
15	Baie Observation	2	-
16	Anse Sauvage	18	-
17	Baie des Trois Ruisseaux	6	-
18	Cap aux Anglais	1	-
19	Pashasibou	2	-
20	Mingan Islands	109	-

Table 7. Number of harbour seals and grey seals observed in the Saguenay River and the two portions of the St. Lawrence Estuary (Upper and Lower) during aerial surveys in 1994–1997 and 2000.

Survey period	Year	Harbour seal					Grey seal				
		South shore	North shore	Saguenay River	Lower Estuary	Upper Estuary	South shore	North shore	Saguenay River	Lower Estuary	Upper Estuary
June	1995	309	100	1[a]	251	158	142	126	0[a]	235	33
	1996	287	179	1	333	133	94	150	0	181	63
	2000	318	199	13	349	168	79	275	0	319	35
August	1994	250	135[b]	4	238[b]	147[b]	108	3[b]	0	52[b]	59[b]
	1995	355	199	24	359	195	192	531	0	665	58
	1996	325	263	39	369	219	341	334	0	533	142
	1997	379	235	45	381	233	299	259	0	436	122

[a] The area of Saint-Fulgence in the Saguenay River was not surveyed due to fog

[b] The north shore was surveyed from east to west and thus, some haul-out sites were not surveyed within 2 h of low tide

Table 8. Mean June, August, and overall abundance of harbour seals (N of ind.) in different zones of the St. Lawrence Estuary and Saguenay River during aerial surveys conducted in 1994–2000. Zones are presented in decreasing order of seal abundance.

Zone	Overall	Zone	June	Zone	August
Bic archipelago	98.0	Bic archipelago	114.0	Batture aux Alouettes	94.0
Batture aux Alouettes	87.3	Batture aux Alouettes	78.3	Île Blanche	87.5
Île Blanche	68.7	Pointe Mitis	64.3	Bic archipelago	86.0
Pointe Mitis	59.1	Île Blanche	43.7	Pointe Mitis	55.3
Hauts-fonds de Mille-Vaches	41.9	Hauts-fonds de Mille-Vaches	29.0	Hauts-fonds de Mille-Vaches	51.5
Batture de Tobin and de l'Île Ronde	31.7	Batture de Tobin and de l'Île Ronde	26.0	Batture de Tobin and de l'Île Ronde	36.0
Batture aux Outardes	30.1	Batture aux Outardes	26.0	Batture aux Outardes	33.3
Île Verte	17.3	Baie des Îlets Jérémie	22.0	Île Verte	27.0
Baie des Îlets Jérémie	16.7	Île aux Fraises	20.3	L'Anse-Saint-Jean - Baie des Ha! Ha!	23.3
L'Anse-Saint-Jean to Baie des Ha! Ha!	15.1	Anse des Riou	8.7	Baie des Îlets Jérémie	12.8
Île aux Fraises	11.0	Battures aux Loups Marins	5.3	Battures aux Gibiers	8.8
Battures aux Loups Marins	5.7	Île Verte	4.3	Rimouski	7.5
Rimouski	5.6	L'Anse-Saint-Jean to Baie des Ha! Ha!	4.3	Battures aux Loups Marins	6.0
Battures aux Gibiers	5.6	Les Pélerins	3.7	Baie Mitis	5.5
Anse des Riou	4.9	Baie Mitis	3.3	Bay of Pointe Saint-Gilles	4.8
Baie Mitis	4.6	Rimouski	3.0	Saint-Ulric	4.7
Bay of Pointe Saint-Gilles	3.3	Île aux Pommes	2.3	Île aux Fraises	4.0
Les Pélerins	2.3	Île aux Basques	2.0	Saguenay River mouth to Anse-St-Jean	3.0
Saint-Ulric	2.1	Battures aux Gibiers	1.3	Battures de Kamouraska	2.3
Saguenay River mouth to Anse-St-Jean	2.0	Bay of Pointe Saint-Gilles	1.3	Anse des Riou	2.0
Battures de Kamouraska	1.3	Pointe-au-Père	1.0	Baie des Ha! Ha! to Saint-Fulgence	1.8
Île aux Pommes	1.0	Anse à Mercier	0.7	Sainte-Luce	1.5
Baie des Ha! Ha! to Saint-Fulgence	1.0	Île aux Lièvres	0.7	Les Pélerins	1.0
Sainte-Luce	0.9	Baie des Rochers	0.7	Île aux Coudres	1.0
Île aux Basques	0.9	Baie Laval	0.7	Rocher Percé	0.8
Rocher Percé	0.6	Saguenay River mouth to Anse-St-Jean	0.7	Anse Sainte-Anne	0.8
Île aux Coudres	0.6	Matane	0.3	Bay of Pointe Rouge	0.8
Baie des Rochers	0.6	Saint-Ulric	0.3	Baie des Rochers	0.5
Pointe-au-Père	0.4	Île Rouge	0.3	Île Rouge	0.3
Île aux Lièvres	0.4	Rocher Percé	0.3	Île aux Lièvres	0.3

Table 8. (Continued)

Zone	Overall	Zone	June	Zone	August
Anse Sainte-Anne	0.4	Sainte-Luce	0.0	Saint-Irénée	0.3
Baie Laval	0.4	Battures de Kamouraska	0.0	Batture à Théophile	0.3
Pointe Rouge	0.4	Anse Sainte-Anne	0.0	Baie Laval	0.3
Anse à Mercier	0.3	Île aux Coudres	0.0	Matane	0.0
Île Rouge	0.3	Saint-Irénée	0.0	Pointe-au-Père	0.0
Matane	0.1	Batture à Théophile	0.0	Anse à Mercier	0.0
Saint-Irénée	0.1	Pointe Rouge	0.0	Île aux Basques	0.0
Batture à Théophile	0.1	Baie des Ha! Ha! to Saint-Fulgence	0.0	Île aux Pommes	0.0

Table 9. Zones where at least one harbour seal was observed during aerial surveys of the St. Lawrence Estuary and Saguenay River in 1994–2000. Zones are presented in decreasing order of frequency of seal occurrence.

Zone	Overall	Zone	June	Zone	August
Pointe Mitis	7	Pointe Mitis	3	Pointe Mitis	4
Bic archipelago	7	Bic archipelago	3	Baie Mitis	4
Batture de Tobin and de l'Île Ronde	7	Anse des Riou	3	Rimouski	4
Île Verte	7	Île aux Basques	3	Bic archipelago	4
Île Blanche	7	Batture de Tobin and de l'Île Ronde	3	Batture de Tobin and de l'Île Ronde	4
Île aux Fraises	7	Île Verte	3	Île Verte	4
Battures aux Loups Marins	7	Île Blanche	3	Île Blanche	4
Batture aux Alouettes	7	Île aux Fraises	3	Île aux Fraises	4
Hauts-fonds de Mille-Vaches	7	Battures aux Loups Marins	3	Battures aux Loups Marins	4
Battures aux Gibiers	7	Batture aux Alouettes	3	Batture aux Alouettes	4
Batture aux Outardes	7	Hauts-fonds de Mille-Vaches	3	Hauts-fonds de Mille-Vaches	4
L'Anse-Saint-Jean to Baie des Ha! Ha!	7	Battures aux Gibiers	3	Battures aux Gibiers	4
Baie Mitis	6	Batture aux Outardes	3	Batture aux Outardes	4
Rimouski	6	Bay of Pointe Saint-Gilles	3	L'Anse-Saint-Jean to Baie des Ha! Ha!	4
Anse des Riou	6	L'Anse-St-Jean to Baie des Ha! Ha!	3	Saint-Ulric	3
Bay of Pointe Saint-Gilles	6	Baie Mitis	2	Sainte-Luce	3
Saint-Ulric	4	Pointe-au-Père	2	Anse des Riou	3
Les Pélerins	4	Rimouski	2	Bay of Pointe Saint-Gilles	3
Baie des Îlets Jérémie	4	Île aux Pommes	2	Saguenay River mouth to Anse-St-Jean	3
Saguenay River mouth to Anse-St-Jean	4	Île aux Lièvres	2	Les Pélerins	2
Sainte-Luce	3	Les Pélerins	2	Battures de Kamouraska	2
Île aux Basques	3	Baie des Rochers	2	Anse Sainte-Anne	2
Île aux Lièvres	3	Baie Laval	2	Île aux Coudres	2
Baie des Rochers	3	Baie des Îlets Jérémie	2	Baie des Îlets Jérémie	2
Baie Laval	3	Matane	1	Bay of Pointe Rouge	2
Pointe-au-Père	2	Saint-Ulric	1	Baie des Ha! Ha! to Saint-Fulgence	2
Île aux Pommes	2	Anse à Mercier	1	Île Rouge	1
Île Rouge	2	Île Rouge	1	Rocher Percé	1
Rocher Percé	2	Rocher Percé	1	Île aux Lièvres	1

Table 9. (Continued)

Zone	Overall	Zone	June	Zone	August
Battures de Kamouraska	2	Saguenay River mouth to Anse St-Jean	1	Saint-Irénée	1
Anse Sainte-Anne	2	Sainte-Luce	0	Baie des Rochers	1
Île aux Coudres	2	Battures de Kamouraska	0	Batture à Théophile	1
Bay of Pointe Rouge	2	Anse Sainte-Anne	0	Baie Laval	1
Baie des Ha! Ha! to Saint-Fulgence	2	Île aux Coudres	0	Matane	0
Matane	1	Saint-Irénée	0	Pointe-au-Père	0
Anse à Mercier	1	Batture à Théophile	0	Anse à Mercier	0
Saint-Irénée	1	Bay of Pointe Rouge	0	Île aux Basques	0
Batture à Théophile	1	Baie des Ha! Ha! to Saint-Fulgence	0	Île aux Pommes	0

Table 10. Estimated rate of increase (± SE) in the number of harbour seals and grey seals in the St. Lawrence Estuary between 1994 and 2000, calculated using non-linear regression analyses and assuming an exponential annual growth rate. Statistically significant relationships are indicated with an asterisk.

Species	Sector	Estimated rate of increase (± SE)		
		June	August	Range
Harbour seal				
	St. Lawrence Estuary	0.046 (0.015)	0.066 (0.009)	
	Upper Estuary	0.026 (0.035)	0.150 (0.034)	
	Lower Estuary	0.050 (0.040)	0.030 (0.001) *	
	North shore	0.106 (0.076)	0.083 (0.115)	
	South shore	0.011 (0.016)	0.116 (0.055)	
	Île Blanche	0.002 (0.053)	0.101 (0.096)	
	Batture aux Alouettes	0.091 (0.016)	0.150 (0.094)	
	Bic	0.038 (0.013)	0.036 (0.091)	
	Pointe Mitis	0.035 (0.005)	0.088 (0.028)	
				0.002–0.150
Grey seal				
	St. Lawrence Estuary	0.066 (0.026)	-0.1295 (0.000) *	
	Upper Estuary	0.084 (0.052)	0.3075 (0.000) *	
	Lower Estuary	-0.034 (0.000) *	-0.2111 (0.000) *	
	North shore	0.155 (0.003) *	- [a]	
	South shore	-0.096 (0.000) *	- [b]	
				-0.096–0.155

[a] The analysis resulted in unrealistically high predicted grey seal numbers in 1994

[b] The analysis resulted in predicted grey seal numbers < 0 in 1994, i.e., an unrealistic value

Table 11. Number of harbour seals and grey seals observed in different regions of the Gulf of St. Lawrence during aerial surveys in June 1996 and 2001. Areas not surveyed are indicated by a dash.

Survey period	Year	Harbour seal					Grey seal				
		SW Gulf	Îles-de-la-Madeleine	Anticosti Island	North shore	PEI	SW Gulf	Îles-de-la-Madeleine	Anticosti Island	North shore	PEI
June	1996	115[a]	32	308	12	-	22[a]	151	2110	111	-
	2001	-	-	-	-	423	-	-	-	-	80

[a] This number does not include observations by partners in unsurveyed areas during the survey period, i.e., 10–40 harbour seals and 6–25 grey seals at Île Plate / Île Bonaventure and 55 grey seals at Kouchibouguac (see Table 2).

Table 12. Mean June, August and overall abundance of grey seals (N of ind.) in different zones of the St. Lawrence Estuary and Saguenay River during aerial surveys conducted in 1994–2000. Zones are presented in decreasing order of seal abundance.

Zone	Overall	Zone	June	Zone	August
Batture aux Outardes	100.9	Betsiamites River mouth	91.7	Batture aux Outardes	110.3
Betsiamites River mouth	75.0	Batture aux Outardes	88.3	Bay of Pointe Saint-Gilles	103.5
Bic archipelago	65.0	Bic archipelago	35.7	Bic archipelago	87.0
Bay of Pointe Saint-Gilles	60.7	Razade d'en Bas	23.3	Île aux Fraises	64.5
Île aux Fraises	46.0	Île aux Fraises	21.3	Betsiamites River mouth	62.5
Île Rouge	26.7	Île aux Lièvres	17.3	Île Rouge	46.8
Razade d'en Bas	10.0	Île Blanche	4.7	Île Blanche	12.8
Île Blanche	9.3	Bay of Pointe Saint-Gilles	3.7	Rocher Percé	11.3
Île aux Lièvres	7.4	Batture de l'Île Ronde	2.3	Pointe Mitis	5.0
Rocher Percé	6.4	Les Pélerins	0.3	Battures aux Gibiers	3.5
Pointe Mitis	2.9	Pointe Mitis	0.0	Battures aux Loups Marins	3.0
Battures aux Gibiers	2.0	Baie Mitis	0.0	Îles de Kamouraska	2.5
Battures aux Loups Marins	1.7	Île Verte	0.0	Grande Baie Saint-Nicolas	1.3
Îles de Kamouraska	1.4	Rocher Percé	0.0	Les Pélerins	1.0
Batture de l'Île Ronde	1.0	Batture de Rivière-du-Loup	0.0	Île Verte	0.8
Les Pélerins	0.7	Île Rouge	0.0	Pointe à Boisvert	0.5
Grande Baie Saint-Nicolas	0.7	Îles de Kamouraska	0.0	Baie Mitis	0.3
Île Verte	0.4	Batture aux Loups Marins	0.0	Batture de Rivière-du-Loup	0.3
Pointe à Boisvert	0.3	Pointe à Boisvert	0.0	Baie des Îlets Jérémie	0.3
Baie Mitis	0.1	Battures aux Gibiers	0.0	Razade d'en Bas	0.0
Batture de Rivière-du-Loup	0.1	Baie des Îlets Jérémie	0.0	Batture de l'Île Ronde	0.0
Baie des Îlets Jérémie	0.1	Grande Baie St-Nicolas	0.0	Île aux Lièvres	0.0

Table 13. Zones where at least one grey seal was observed during aerial surveys of the St. Lawrence Estuary and Saguenay River in 1994–2000. Zones are presented in decreasing order of frequency of seal occurrence.

Zone	Overall	Zone	June	Zone	August
Bic archipelago	7	Bic archipelago	3	Pointe Mitis	4
Île Blanche	6	Razade d'en Bas	2	Bic archipelago	4
Île aux Fraises	6	Île Blanche	2	Île Blanche	4
Batture aux Outardes	6	Île aux Fraises	2	Île aux Fraises	4
Pointe Mitis	4	Batture aux Outardes	2	Îles de Kamouraska	4
Îles de Kamouraska	4	Batture de l'Île Ronde	1	Batture aux Outardes	4
Bay of Pointe Saint-Gilles	4	Île aux Lièvres	1	Rocher Percé	3
Rocher Percé	3	Les Pélerins	1	Île Rouge	3
Île Rouge	3	Betsiamites River mouth	1	Battures aux Gibiers	3
Les Pélerins	3	Bay of Pointe Saint-Gilles	1	Bay of Pointe Saint-Gilles	3
Battures aux Gibiers	3	Pointe Mitis	0	Île Verte	2
Razade d'en Bas	2	Baie Mitis	0	Les Pélerins	2
Île Verte	2	Île Verte	0	Battures aux Loups Marins	2
Battures aux Loups Marins	2	Rocher Percé	0	Grande Baie Saint-Nicolas	2
Betsiamites River mouth	2	Batture de Rivière-du-Loup	0	Baie Mitis	1
Grande Baie Saint-Nicolas	2	Île Rouge	0	Batture de Rivière-du-Loup	1
Baie Mitis	1	Îles de Kamouraska	0	Pointe à Boisvert	1
Batture de l'Île Ronde	1	Batture aux Loups Marins	0	Baie des Îlets Jérémie	1
Batture de Rivière-du-Loup	1	Pointe à Boisvert	0	Betsiamites River mouth	1
Île aux Lièvres	1	Battures aux Gibiers	0	Razade d'en Bas	0
Pointe à Boisvert	1	Baie des Îlets Jérémie	0	Batture de l'Île Ronde	0
Baie des Îlets Jérémie	1	Grande Baie Saint-Nicolas	0	Île aux Lièvres	0

Table 14. Human activities observed in the St. Lawrence Estuary and Saguenay River during aerial surveys in 1994–2000. "Zone ID" numbers are presented in Figure 3.

Date	Type of disturbance	Area	Zone	Zone ID
22 August 94	People walking	St-Fabien - Cap à l'Orignal	Bic archipelago	8
26 August 94	9 kayaks	Baie Ste-Marguerite	Saguenay River mouth to L'Anse-St-Jean	36
15 June 95	1 watercraft	N side of Grande-Île	Battures de Kamouraska	21
15 June 95	1 watercraft	NW of Île Brulée	Battures de Kamouraska	21
17 June 95	2 jet skis	48°22.60 70°36.43	L'Anse-Saint-Jean to Baie des Ha! Ha!	37
13 August 95	Kayak and people on beach	Île aux Basques	Île aux Basques	11
13 August 95	2 groups of kayaks	Île de Kamouraska	Battures de Kamouraska	21
14 August 95	Several boats and clam digging	Baie des Plongeurs	Baie Laval	30
16 August 95	Sea-doo and 3 kayaks	Anse Saint-Étienne	Saguenay River mouth to L'Anse-St-Jean	36
16 August 95	Tour boat	Île Saint-Louis	Saguenay River mouth to L'Anse-St-Jean	36
16 August 95	3 kayaks	Baie de la Trinité	L'Anse-Saint-Jean to Baie des Ha! Ha!	37
16 August 95	3 kayaks	Saint-Honoré	Baie des Ha! Ha! to Saint-Fulgence	38
16 August 95	4 kayaks	Sainte-Rose-du-Nord	L'Anse-Saint-Jean to Baie des Ha! Ha!	37
16 August 95	7 kayaks	Baie Sainte-Marguerite	Saguenay River mouth to L'Anse-St-Jean	36
16 August 95	7 kayaks	Downstream of Baie Sainte-Marguerite	Saguenay River mouth to L'Anse-St-Jean	36
18 August 96	People on tidal flats	Baie du Ha-Ha, Bic	Bic archipelago	8
19 August 96	4 kayaks	Sainte-Rose-du-Nord	L'Anse-Saint-Jean to Baie des Ha! Ha!	37
19 August 96	6 kayaks	Sainte-Rose-du-Nord	L'Anse-Saint-Jean to Baie des Ha! Ha!	37
19 August 96	9 kayaks	Opposite to Île Saint-Louis	Saguenay River mouth to L'Anse-St-Jean	36
19 August 96	1 kayak	Baie Sainte-Marguerite	Saguenay River mouth to L'Anse-St-Jean	36
19 August 96	4 kayaks	Downstream of Baie Sainte-Marguerite	Saguenay River mouth to L'Anse-St-Jean	36
20 August 97	Source not indicated	Baie Mitis	Baie Mitis	4
20 August 97	Kayaks	Pointe à Rioux	Anse des Riou	10
20 August 97	People on Île aux Basques	Batture de Tobin	Batture de Tobin and de l'Île Ronde	13
24 August 97	Fishermen	Petit Saguenay	Saguenay River mouth to L'Anse-St-Jean	36
24 August 97	2 kayaks	Upstream of Sacré-Cœur	Saguenay River mouth to L'Anse-St-Jean	36
24 August 97	1 kayak	Baie Éternité	L'Anse-Saint-Jean to Baie des Ha! Ha!	37
24 August 97	2 kayaks	Upstream of Baie Éternité	L'Anse-Saint-Jean to Baie des Ha! Ha!	37
24 August 97	Fishermen	Bay downstream of Baie des Ha! Ha!	L'Anse-Saint-Jean to Baie des Ha! Ha!	37
24 August 97	2 kayaks	La Baie	Baie des Ha! Ha! to Saint-Fulgence	38
24 August 97	Sea-doo	Downstream of La Baie	Baie des Ha! Ha! to Saint-Fulgence	38

Table 14. (Continued)

Date	Type of disturbance	Area	Zone	Zone id
24 August 97	3 kayaks	Downstream of Cap de l'Est	Baie des Ha! Ha! to Saint-Fulgence	38
24 August 97	3 kayaks	Downstream of Cap de l'Est	Baie des Ha! Ha! to Saint-Fulgence	38
19 June 2000	Clam digging	Bay opposite Anse à l'Orignal	Bic archipelago	8

Table 15. Human activities observed in different areas of the Gulf of St. Lawrence during aerial surveys in June 1996 and 2001. "Zone ID" numbers are presented in Figure 5.

Date	Type of disturbance	Area	Zone	Zone ID
15 June 1996	Commercial ship	Durham Center	SW Gulf	
21 June 1996	Boats and people on land	Île Nue	Mingan Archipelago	20
22 June 1996	3 boats	Île à la Chasse	Mingan Archipelago	20
23 June 1996	Several boats	Île aux Oeufs	North shore	
12 June 2001	Several fishing boats	New London Bay	N shore of PEI	
12 June 2001	Several boats	Hog Island	NW shore of PEI	
12 June 2001	People on beach	North Cape	NW shore of PEI	
12 June 2001	People on beach	Campbelton	W shore of PEI	
12 June 2001	2 boats	West of Brae Harbour	SW shore of PEI	
12 June 2001	Aquaculture	Wolf Inlet	SW shore of PEI	
12 June 2001	Several boats	Percival Bay	SW shore of PEI	
12 June 2001	People on beach	Fifteen Point	S shore of PEI	
12 June 2001	People on beach	Ives Point	S shore of PEI	
12 June 2001	People on beach	Seacow Head	S shore of PEI	
12 June 2001	People in water	Victoria Point	S shore of PEI	
13 June 2001	7 boats	Cape Bear	Murray Head area, PEI	7
13 June 2001	Several boats and aquaculture	Bay of Murray Head	Murray Head area, PEI	7
13 June 2001	Aquaculture	Bay near Georgetown	E shore of PEI	
13 June 2001	Several boats	Boughton Island	E shore of PEI	
13 June 2001	Several boats	Cape Spy	Rollo Bay, PEI	8
13 June 2001	People on beach	Deane Point	E shore of PEI	
13 June 2001	People on beach	North of Basin Head	E shore of PEI	
13 June 2001	Several boats	East Point	E shore of PEI	
13 June 2001	People on beach	Cable Head Provincial Park	E shore of PEI	

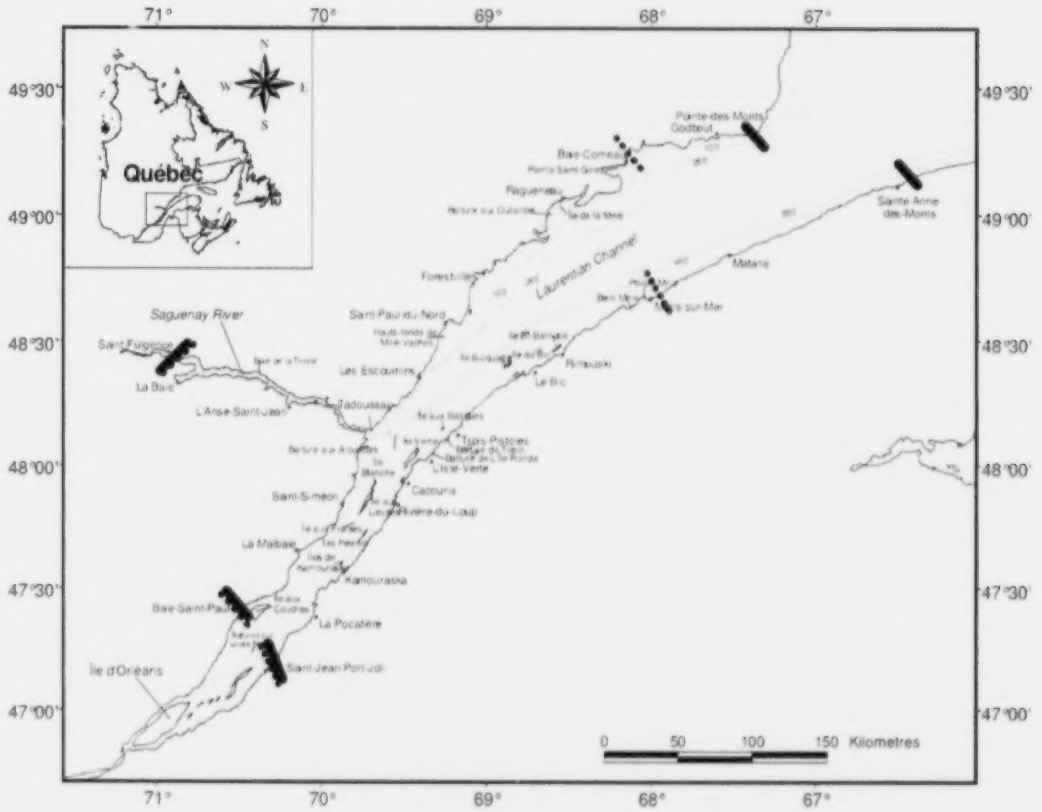


Figure 1. Area covered during the 1994–1997 and 2000 aerial surveys for pinnipeds in the St. Lawrence Estuary and Saguenay River. Areas exposed at low tide are shaded. Lines across the coastlines represent survey boundaries in 1994 (dotted line) and in 1995–1997 and 2000 (solid line).

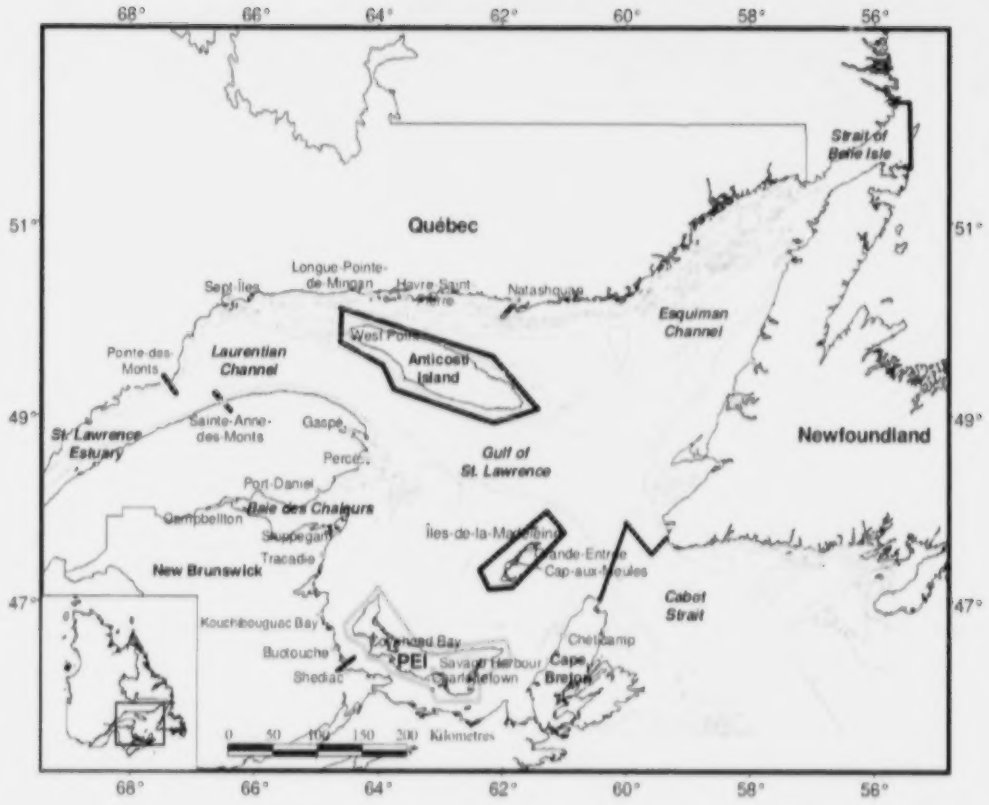


Figure 2. Coastal area covered during the June 1996 (▬▬) and 2001 (——) aerial surveys for pinnipeds in the Gulf of St. Lawrence. Lines across the coasts represent survey boundaries. The solid lines across Cabot Strait and the Strait of Belle Isle delimit the study area. Dotted lines represent the 100 m and 200 m isobath contours.

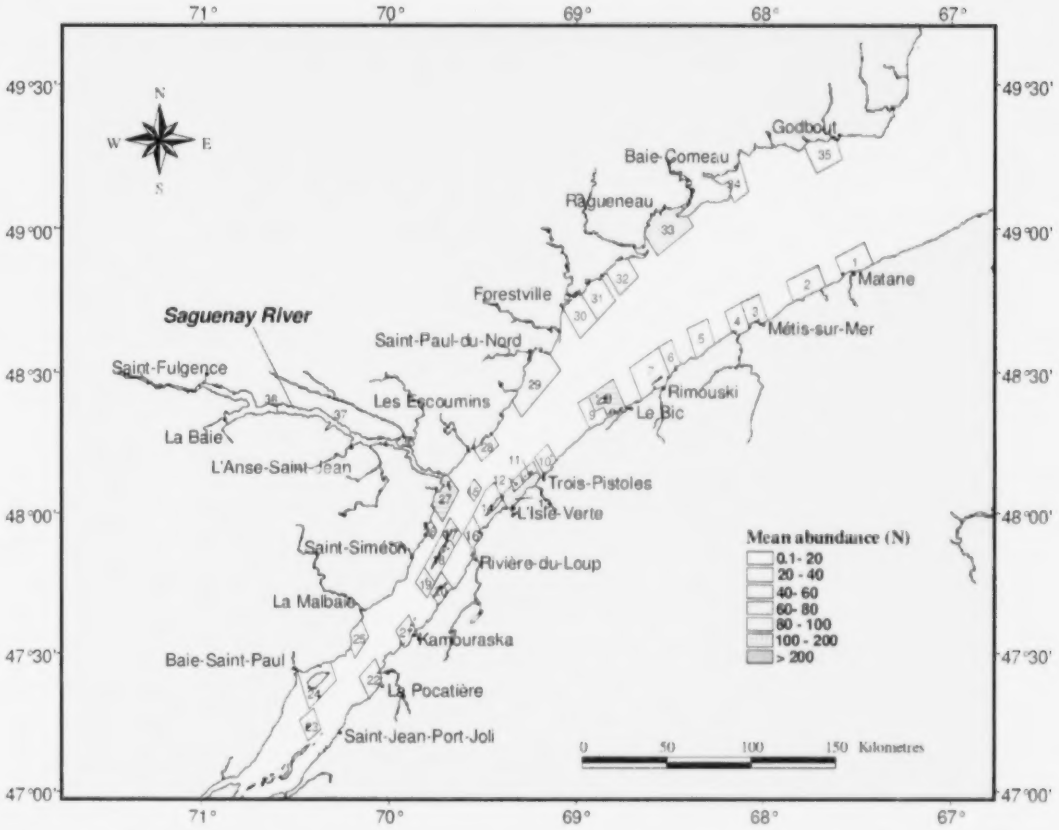


Figure 3. Distribution and mean abundance (N of ind.) of harbour seals observed during aerial surveys flown in the St. Lawrence Estuary and Saguenay River during 1994–2000. The numbers of harbour seal sightings in each zone (numbered in the figure) and each survey are presented in Table 3.

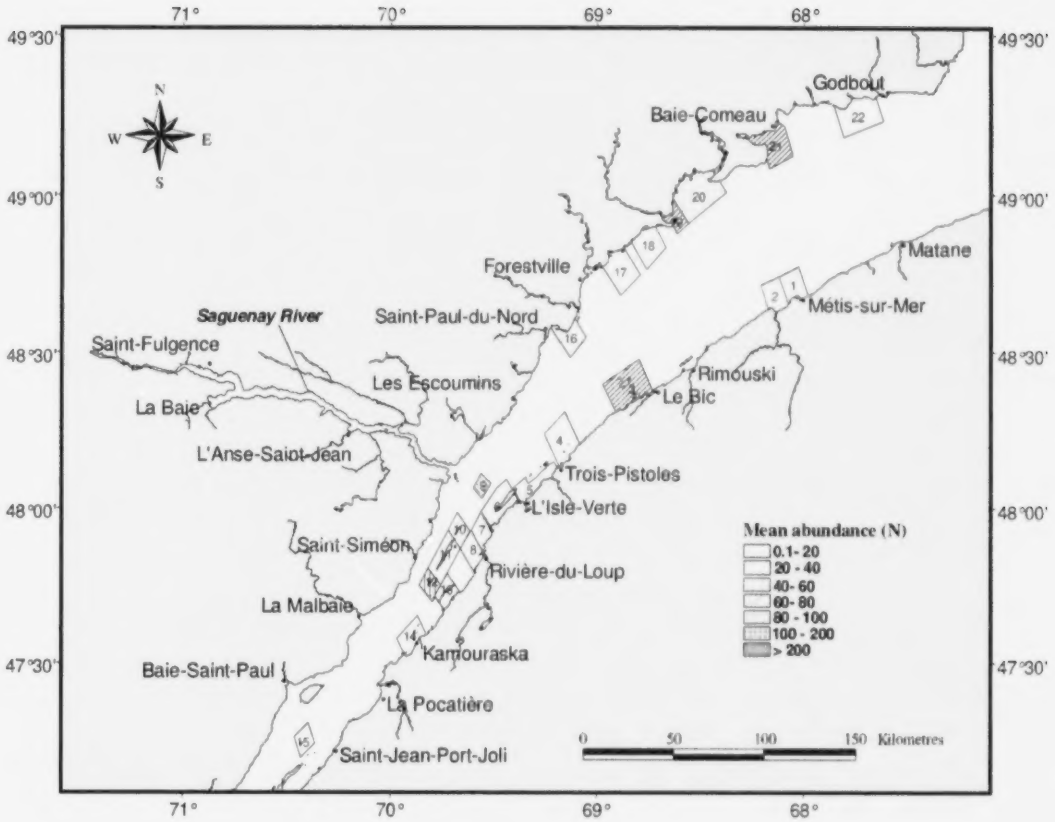


Figure 4. Distribution and mean abundance (N of ind.) of grey seals observed during aerial surveys flown in the St. Lawrence Estuary and Saguenay River during 1994–2000. The numbers of grey seal sightings in each zone (numbered in the figure) during each survey are presented in Table 4.

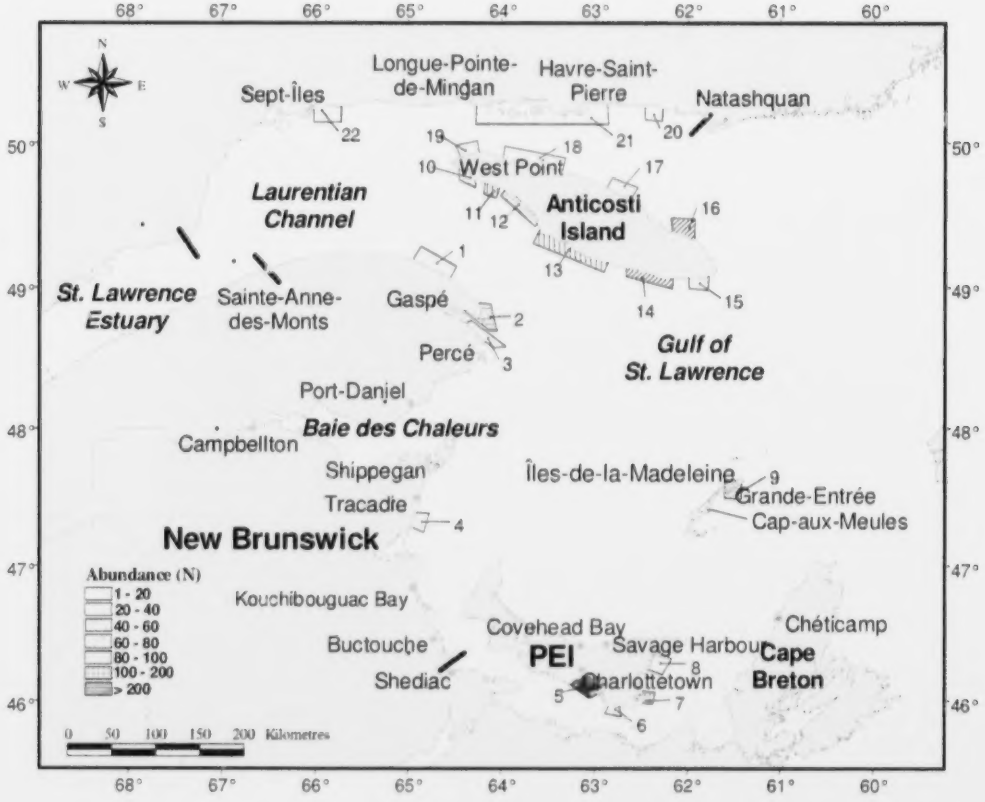


Figure 5. Distribution and mean abundance (N of ind.) of harbour seals observed during aerial surveys flown in the Gulf of St. Lawrence in June 1996 and 2001. The numbers of harbour seal sightings in each zone (numbered in the figure) during each survey are presented in Table 5.

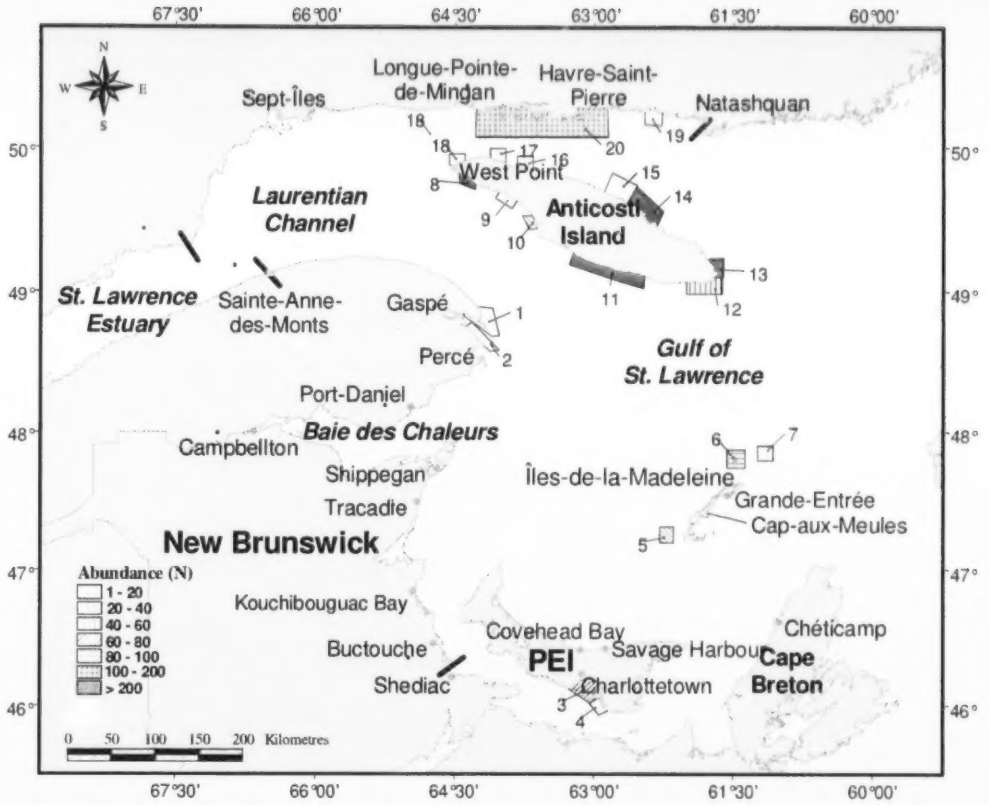


Figure 6. Distribution and mean abundance (N of ind.) of grey seals observed during aerial surveys flown in the Gulf of St. Lawrence in June 1996 and 2001. The numbers of grey seal sightings in each zone (numbered in the figure) during each survey are presented in Table 6.

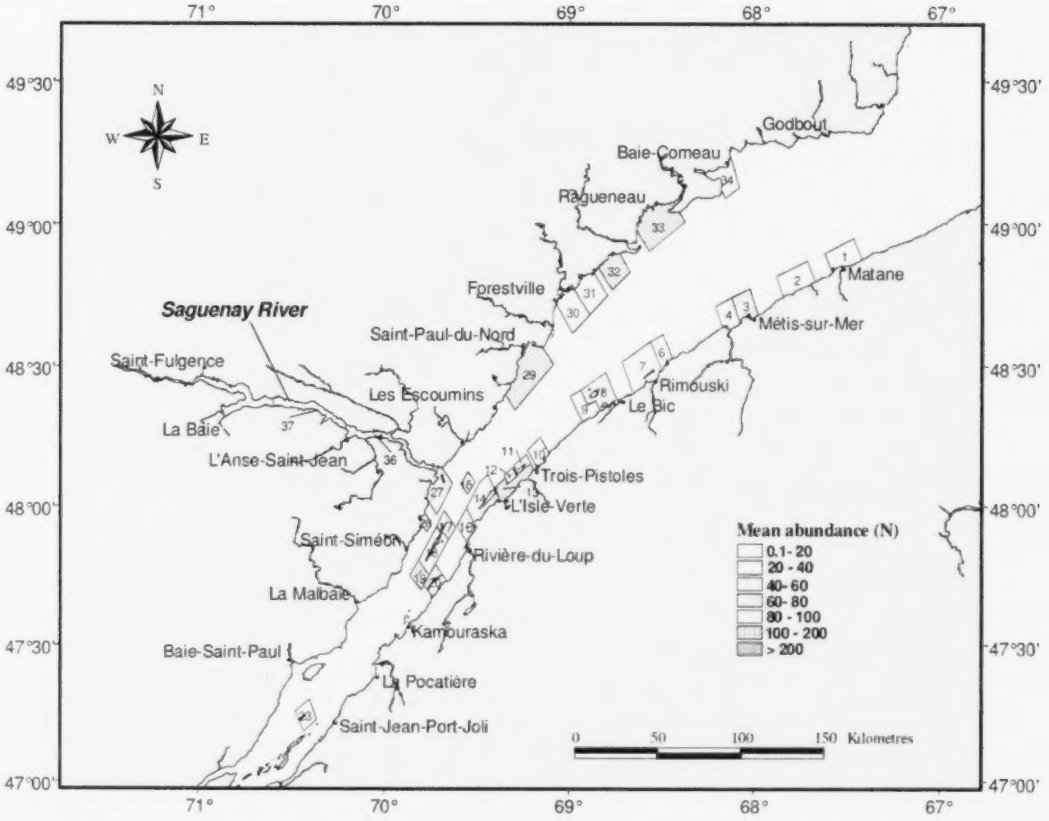


Figure 7. Distribution and mean abundance (N of ind.) of harbour seals observed during June aerial surveys flown in the St. Lawrence Estuary and Saguenay River during 1994–2000. The numbers of harbour seal sightings in each zone (numbered in the figure) during each survey are presented in Table 3.

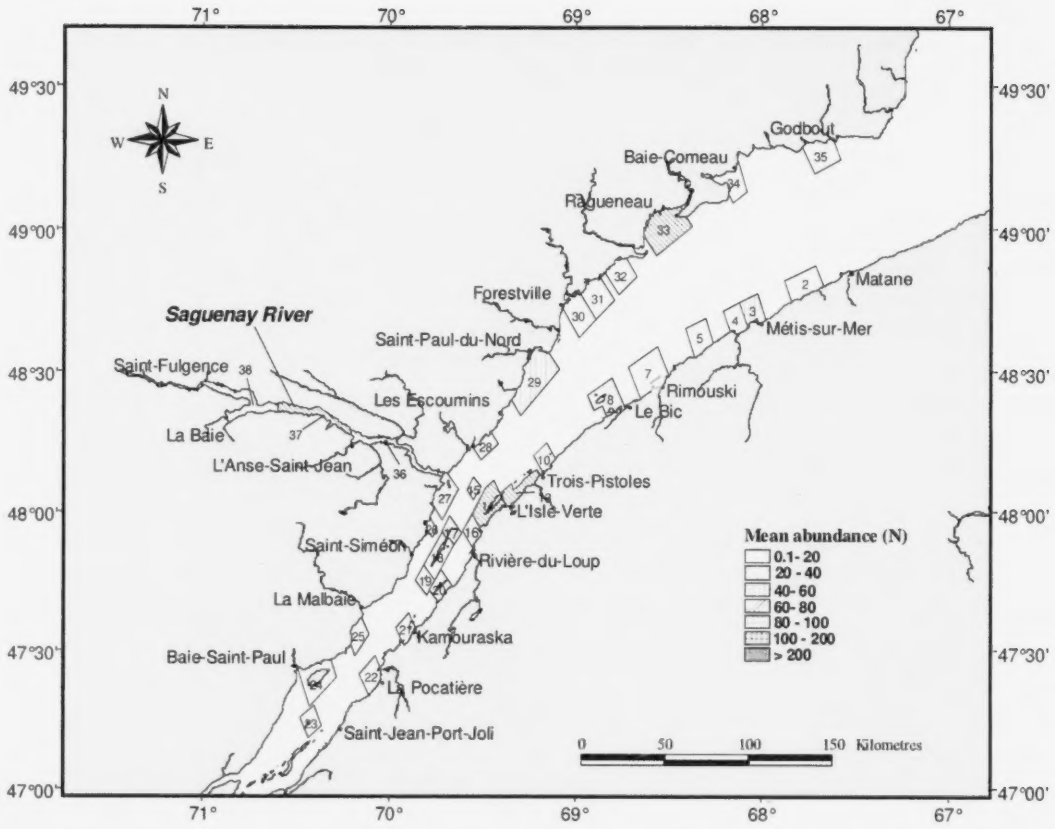


Figure 8. Distribution and mean abundance (N of ind.) of harbour seals observed during August aerial surveys flown in the St. Lawrence Estuary and Saguenay River during 1994–2000. The numbers of harbour seal sightings in each zone (numbered in the figure) during each survey are presented in Table 3.

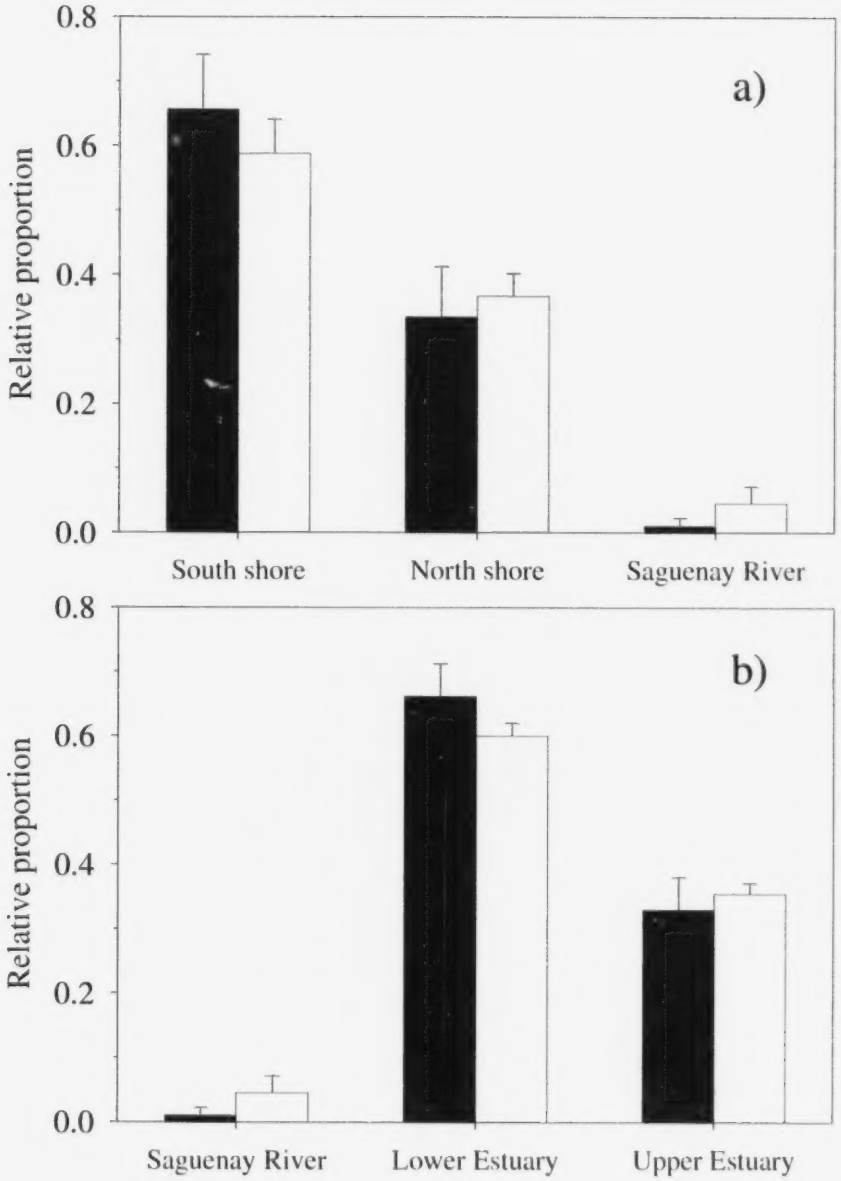


Figure 9. Relative distribution of harbour seals (mean ± SD) a) along the south vs north shore and the Saguenay River and b) in the upstream vs downstream portions of the Estuary and the Saguenay River during June (black bars) and August (white bars) aerial surveys.

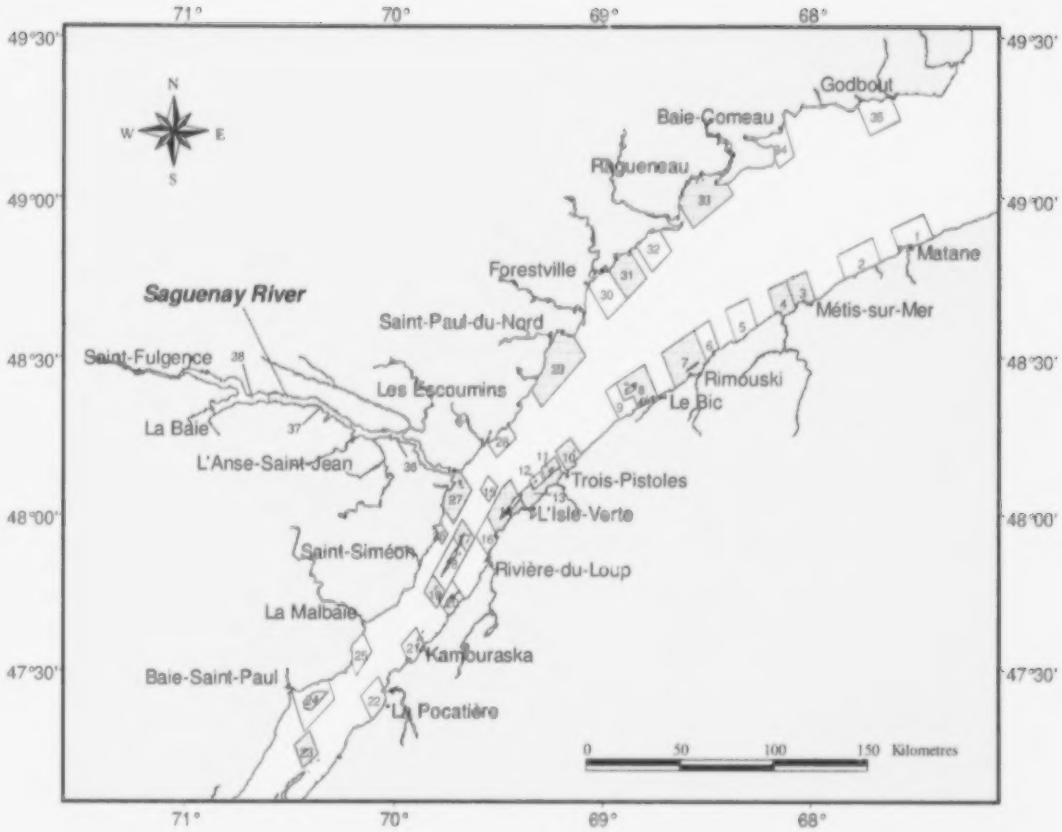


Figure 10. Zones where at least one harbour seal pup was observed during June aerial surveys of the St. Lawrence Estuary and Saguenay River during 1994–2000 (shaded areas). Numbers refer to zones in Table 3.

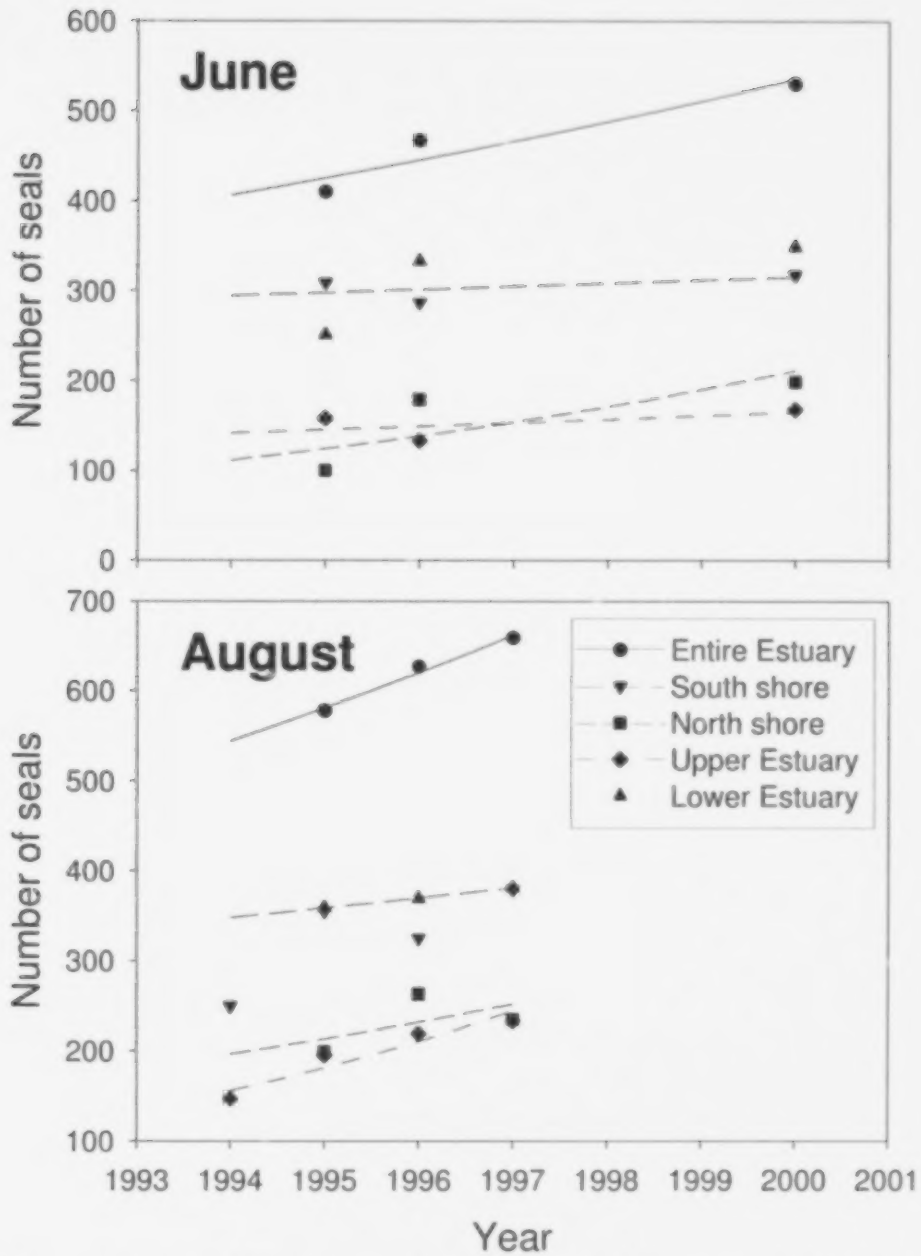


Figure 11. Exponential rate of increase of harbour seals in different portions of the St. Lawrence Estuary and the Estuary as a whole, as determined from aerial surveys in 1994–2000.

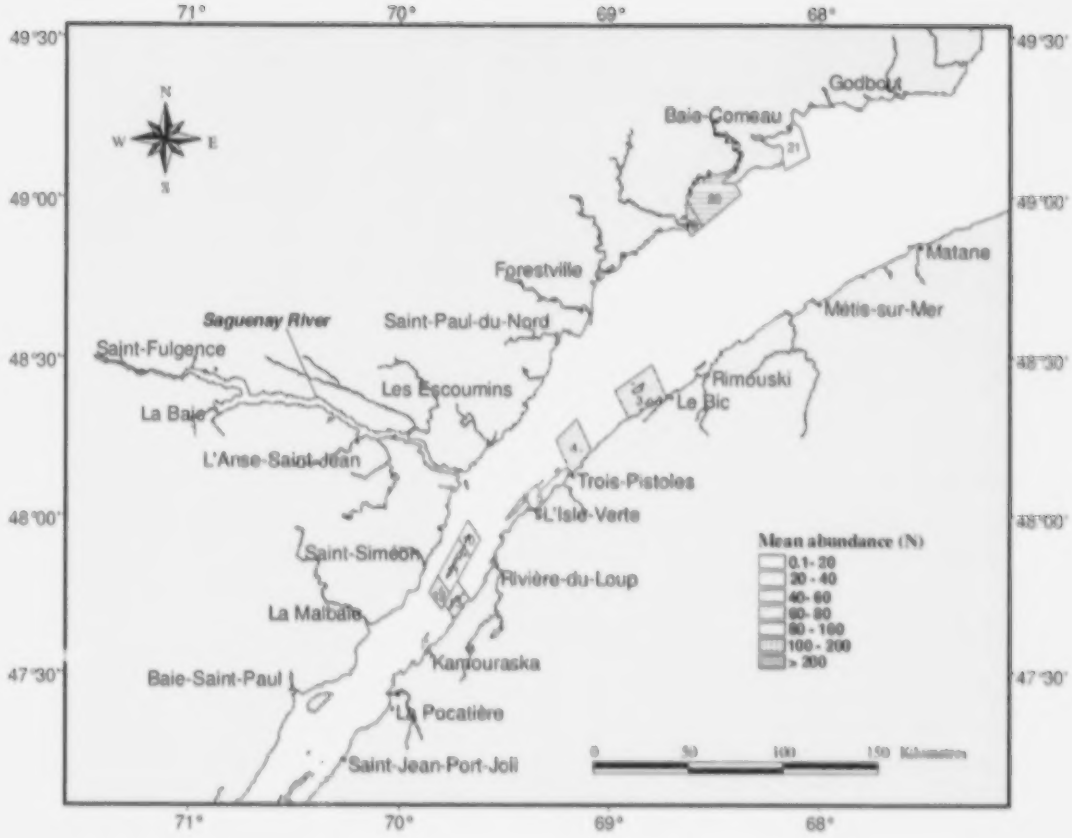


Figure 12. Distribution and mean abundance (N of ind.) of grey seals observed during June aerial surveys flown in the St. Lawrence Estuary and Saguenay River during 1994–2000. The numbers of grey seal sightings during each survey and in each zone (numbered in the figure) are presented in Table 4.

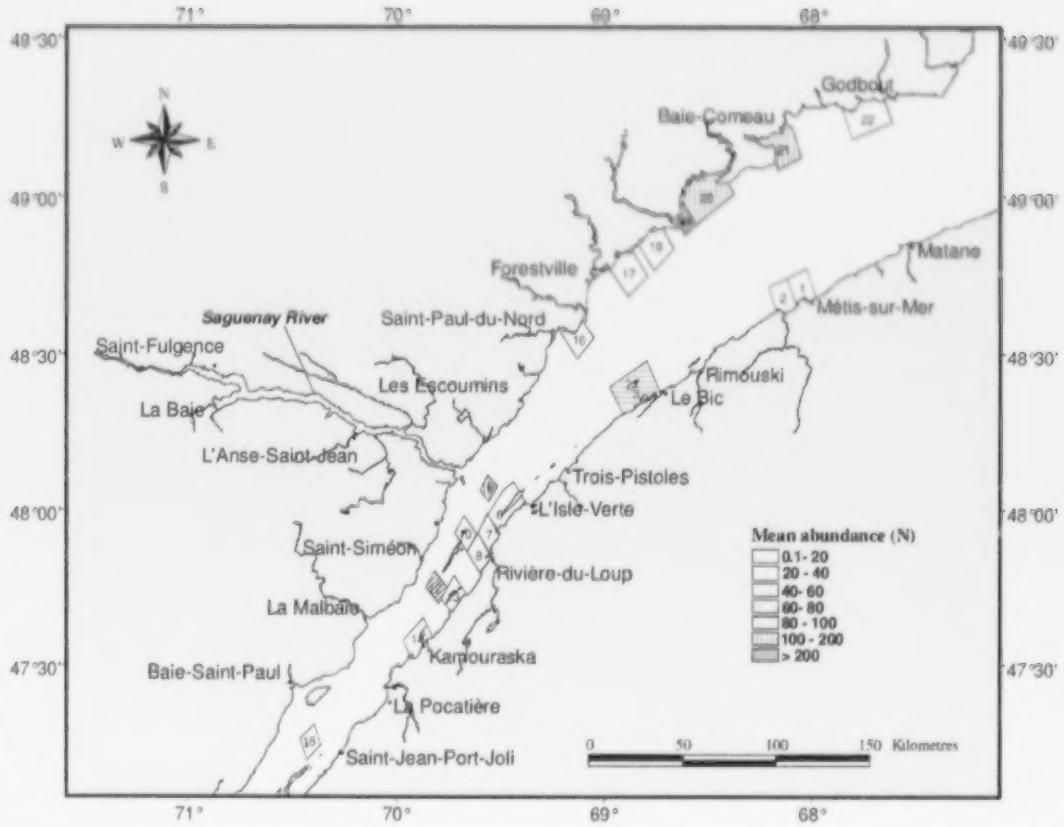


Figure 13. Distribution and mean abundance (N of ind.) of grey seals observed during August aerial surveys flown in the St. Lawrence Estuary and Saguenay River during 1994–2000. The numbers of grey seal sightings during each survey and in each zone (numbered in the figure) are presented in Table 4.

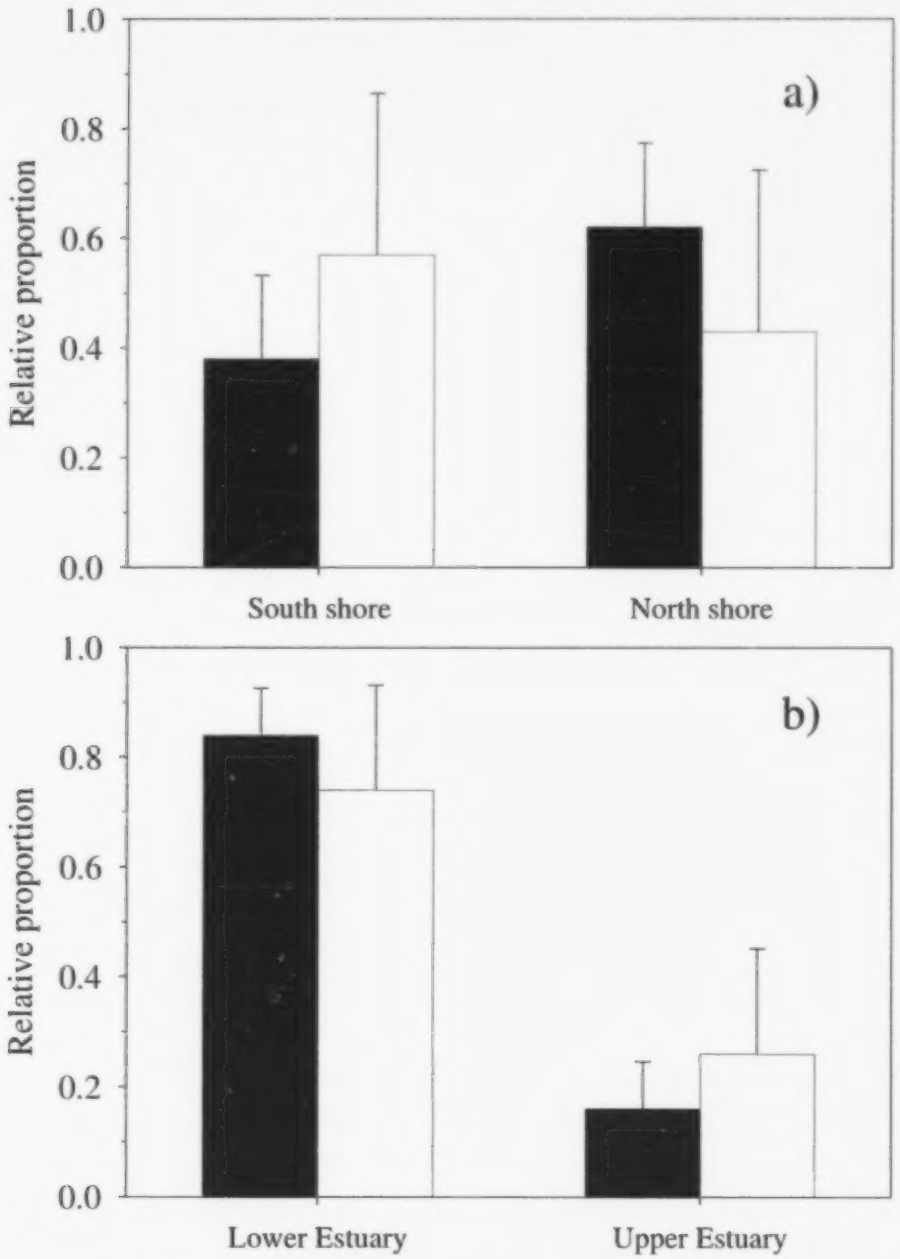


Figure 14. Relative distribution of grey seals (mean ± SD) a) along the south vs north shore and b) in the upper vs lower portions of the Estuary during June (black bars) and August (white bars) aerial surveys.

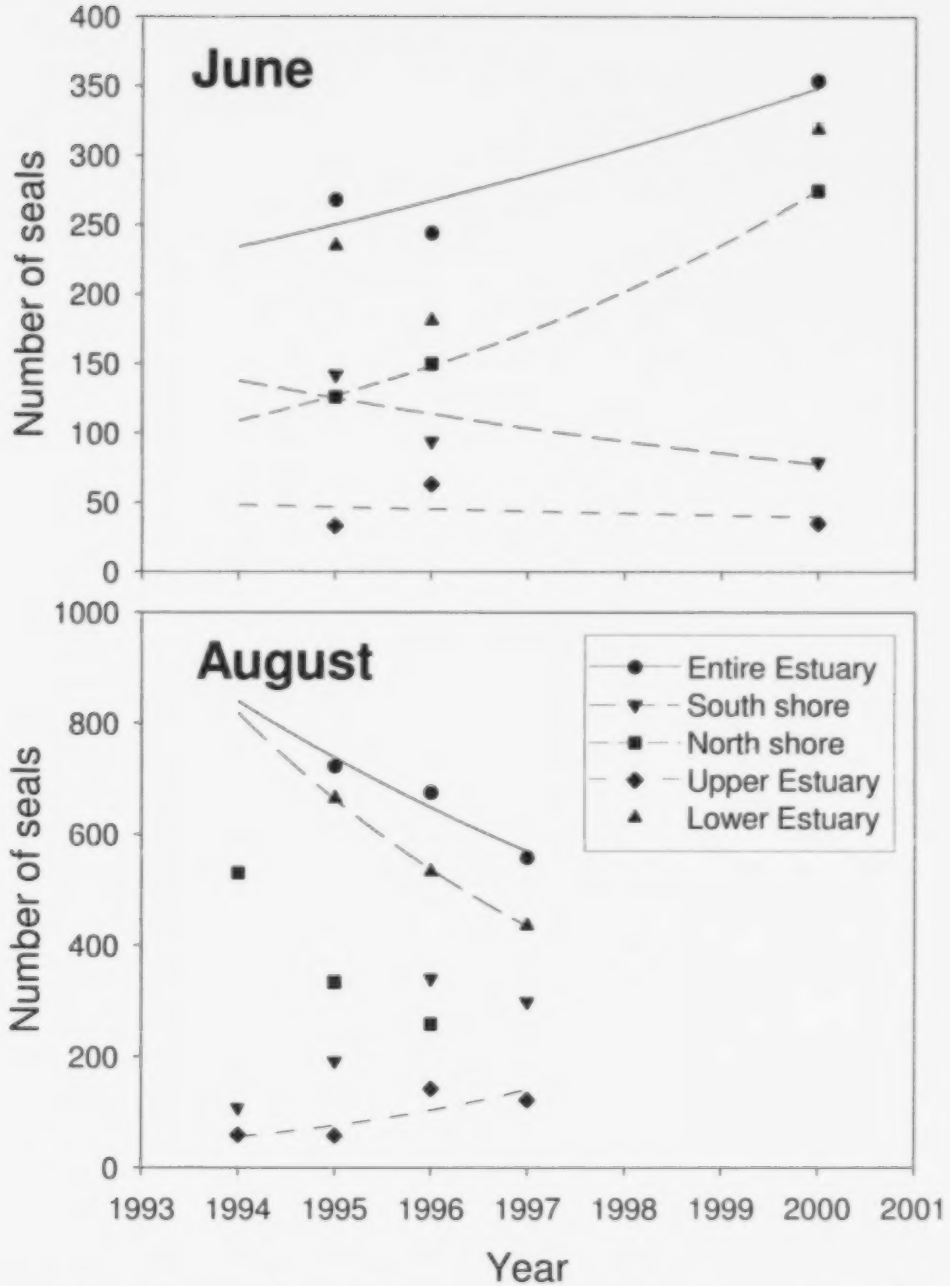


Figure 15. Exponential rate of increase of grey seals in different portions of the St. Lawrence Estuary and the Estuary as a whole, as determined from aerial surveys in 1994–2000.

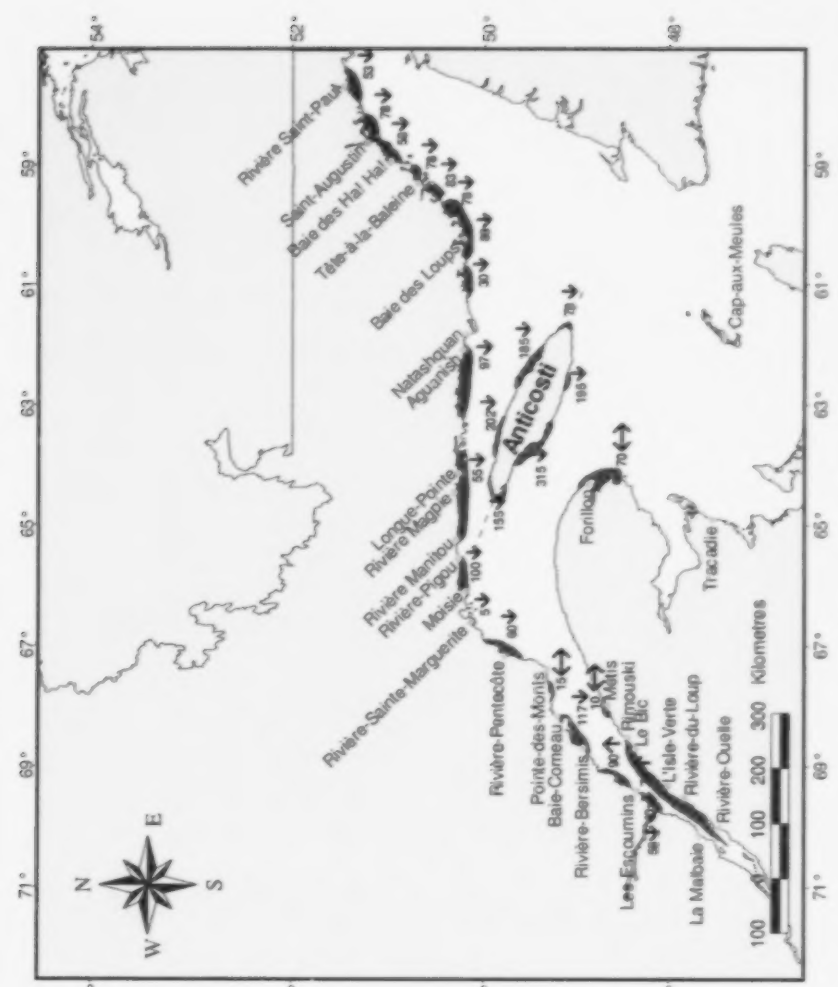


Figure 16. Index estimate of abundance (N), trends (arrows), and distribution (shaded areas) of harbour seals in the Estuary and northern Gulf of St. Lawrence (excluding western Newfoundland) in 1978 (from Lavigne 1978).

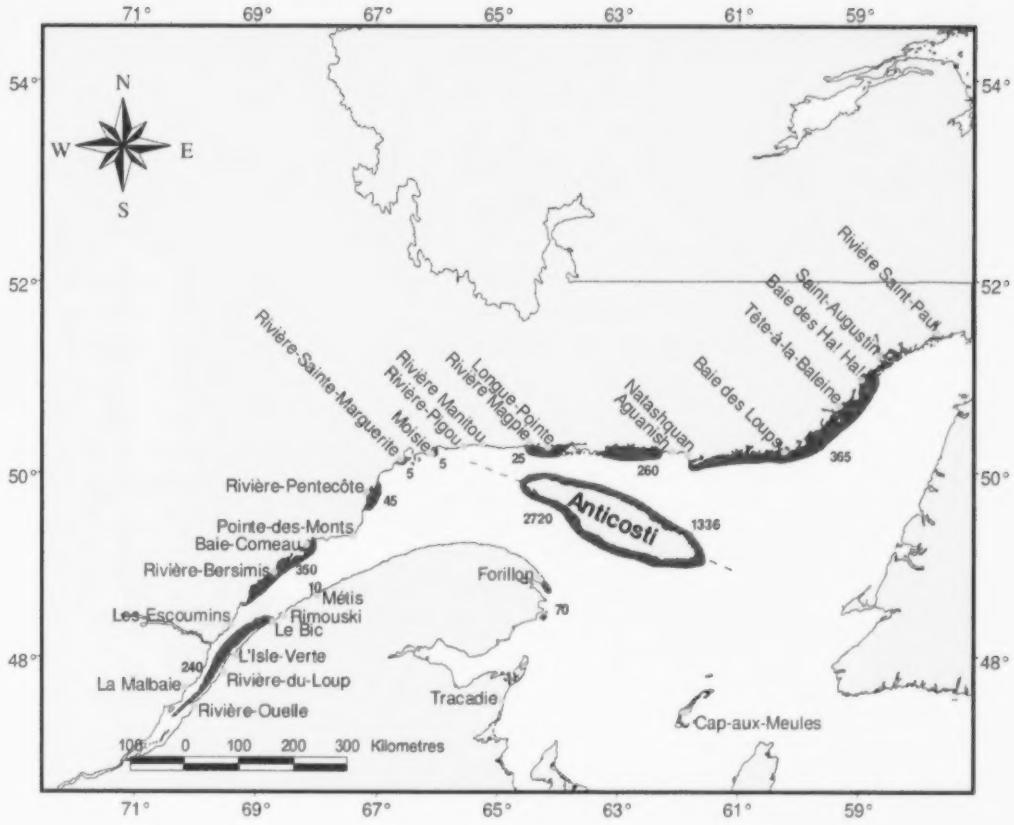


Figure 17. Index estimate of abundance (N) and distribution (shaded areas) of grey seals in the Estuary and northern Gulf of St. Lawrence (excluding western Newfoundland) in 1978 (from Lavigne 1978).

APPENDIX I

Survey times of specific areas relative to low tide (hh:min) during aerial surveys

Appendix I.1. Survey times of the St. Lawrence Estuary and Saguenay River in 1994–2000 relative to low tide. Areas not surveyed are indicated by a dash.

Area	1994	1995		1996		1997	2000	Range	
	August	June	August	June	August	August	June	min	max
South shore and islands									
Sainte-Anne-des-Monts	-	-02:58	-03:09	-02:54	-02:13	-03:13	-03:05	-03:13	-02:13
Saint-Ulric	-	-02:33	-02:23	-02:16	-01:16	-02:26	-02:23	-02:33	-01:16
Pointe Mitis	-01:32	-02:07	-02:23	-02:17	-01:16	-02:29	-02:09	-02:29	-01:16
Île Saint-Barnabé	-00:58	-00:53	-01:22	-01:08	-00:51	-01:54	-01:19	-01:54	-00:53
Île du Bic	-00:30	-00:17	-00:58	-00:35	00:09	-01:17	-00:54	-01:17	00:09
Batture de Tobin	00:09	00:26	-00:21	00:07	00:47	-00:25	-00:03	-00:25	00:47
Île Rouge	00:23	00:45	00:12	00:24	01:07	-00:03	01:48	-00:03	01:48
Île Blanche	00:17	00:36	00:13	00:19	00:38	-00:04	00:05	-00:04	00:38
Île aux Fraises	02:20	01:59	01:38	01:58	01:59	01:27	00:17	00:17	02:20
Batture de Rivière-du-Loup	02:34	01:19	00:41	01:14	01:22	00:58	01:07	00:41	02:34
Les Pélerins	01:31	01:35	00:54	01:27	01:40	01:21	01:15	00:54	01:31
Batture aux Loups Marins	01:39	01:09	00:14	00:56	00:50	00:32	00:40	00:14	01:39
Île aux Coudres	02:53	02:19	01:28	01:59	01:55	01:42	01:49	01:28	02:53
North Shore									
Pointe-des-Monts	-	-02:07	-02:01	-02:14	-02:10	-02:06	-01:07	-02:14	-01:07
Pointe Saint-Gilles	04:15	-01:27	-01:23	-01:36	-01:43	-01:34	-00:57	-01:43	04:15
Île de la Mine	03:30	-01:03	-01:11	-01:10	-01:23	-01:12	-00:49	-01:23	03:30
Baie Laval	02:13	-00:05	-01:29	-00:37	-00:34	-00:20	-00:17	-01:29	02:13
Forestville	02:53	00:39	-00:38	00:00	-00:33	00:02	-00:13	-00:38	02:53
Hauts-fonds de Mille-Vaches	00:43	-01:55	00:09	00:01	-00:39	-00:16	-00:30	-01:55	00:43
Batture aux Alouettes	-00:15	00:49	01:00	00:35	00:36	00:12	01:13	-00:15	01:13
Baie des Rochers	-00:30	01:21	01:38	00:54	01:05	00:41	01:32	-00:30	01:38
La Malbaie	-01:52	00:59	00:51	00:09	00:41	00:08	00:54	-01:52	00:59
Baie-St-Paul	-02:41	00:59	00:53	00:08	00:25	-00:05	00:37	-02:41	00:59

Appendix I.1. (Continued)

Area	1994	1995		1996		1997	2000	Range	
	August	June	August	June	August	August	June	min	max
Saguenay River									
Flying upstream									
Baie Sainte-Catherine	-04:10	-01:18	-00:48	-00:45	-01:18	-01:09	-01:23	-04:10	-00:45
L'Anse-Saint-Jean	-04:03	-00:31	-00:37	-00:38	-01:13	-00:53	-01:05	-04:03	-00:31
Baie Éternité	-03:56	-00:24	-00:30	-00:29	-01:09	-00:45	-01:01	-03:56	-00:24
Baie des Ha! Ha!	-03:35	-[a]	-00:04	-00:19	-00:28	-00:27	-00:47	-03:35	-00:04
SW of Saint-Fulgence	-03:30	-[a]	00:04	-00:05	-00:21	-00:13	-00:37	-03:30	00:04
Flying downstream									
Saint-Fulgence	-03:05	-[a]	00:44	01:02	-00:09	-00:07	-00:37	-03:05	01:02
Sainte-Rose-du-Nord	-02:44	-00:09	01:02	01:13	00:00	00:10	-00:24	-02:44	01:13
NE of L'Anse-Saint-Jean	-02:40	00:03	01:13	01:24	00:35	00:21	-00:15	-02:40	01:24
Baie Sainte-Marguerite	-02:22	00:17	01:31	01:33	00:36	00:38	00:04	-02:22	01:33
Tadoussac	-01:56	00:44	01:52	01:54	01:09	01:01	00:18	-01:56	01:54

[a] Not surveyed due to fog

Appendix I.2. Surveys timers of the Gulf of St. Lawrence in 1996 and 2001 relative to low tide. Areas not surveyed are indicated by a dash.

Area	Date	1996	2001
		June	June
Western Gulf			
Ste-Anne-des-Monts	15	-01:50	-
Cloridorme	15	-01:06	-
Gaspé	15	00:00	-
Newport	15	01:01	-
Carleton	15	02:12	-
Pointe Verte	15	03:35	-
Birch Point	15	05:17	-
Southwestern Gulf			
Tabunsinctac Bay	16	-04:24	-
Escuminac Point	16	-03:06	-
Shediac Bay	16	02:18	-
Îles-de-la-Madeleine			
Shag Island	17	03:07	-
Île Brion	17	03:33	-
Rocher aux Oiseaux	17	03:48	-
Île Le Corps-Mort	17	06:05	-
Anticosti Island	21		
Pointe-Ouest	21	-00:33	-
Pointe-Sud-Ouest	21	-00:34	-
Cap des Caps	21	00:00	-
Pointe Heath	21	02:45	-
Baie Natiscotec	21	04:05	-
Anse du Brick	21	02:45	-
Cap de Rabast	21	03:02	-
North shore			
Natashquan	22	-00:57	-
Grande Île	22	-00:16	-
Sheldrake	22	00:37	-
Sept-Îles	22	01:33	-
Sept-Îles	23	-01:20	-
Pointe-des-Monts	23	-00:33	-

Appendix I.2. (Continued).

Area	Date	1996	2001
		June	June
Prince Edward Island			
Hillsborough Bay	12	-	01:14
Prim Point	12	-	02:04
Covehead	12	-	-05:42
North Cape	12	-	-04:26
Campbelton	12	-	-02:47
Percival Bay	12	-	00:47
Cape Egmont	12	-	02:53
Victoria	12	-	05:19
Hillsborough Bay	13	-	-01:02
Big Point	13	-	-00:37
Cape Bear	13	-	01:12
East Point	13	-	04:57
Tracadie Bay	13	-	-07:53

APPENDIX II

Harbour seals

Sightings in the Estuary and Gulf of St. Lawrence during aerial surveys flown in 1994–1997, 2000, and 2001

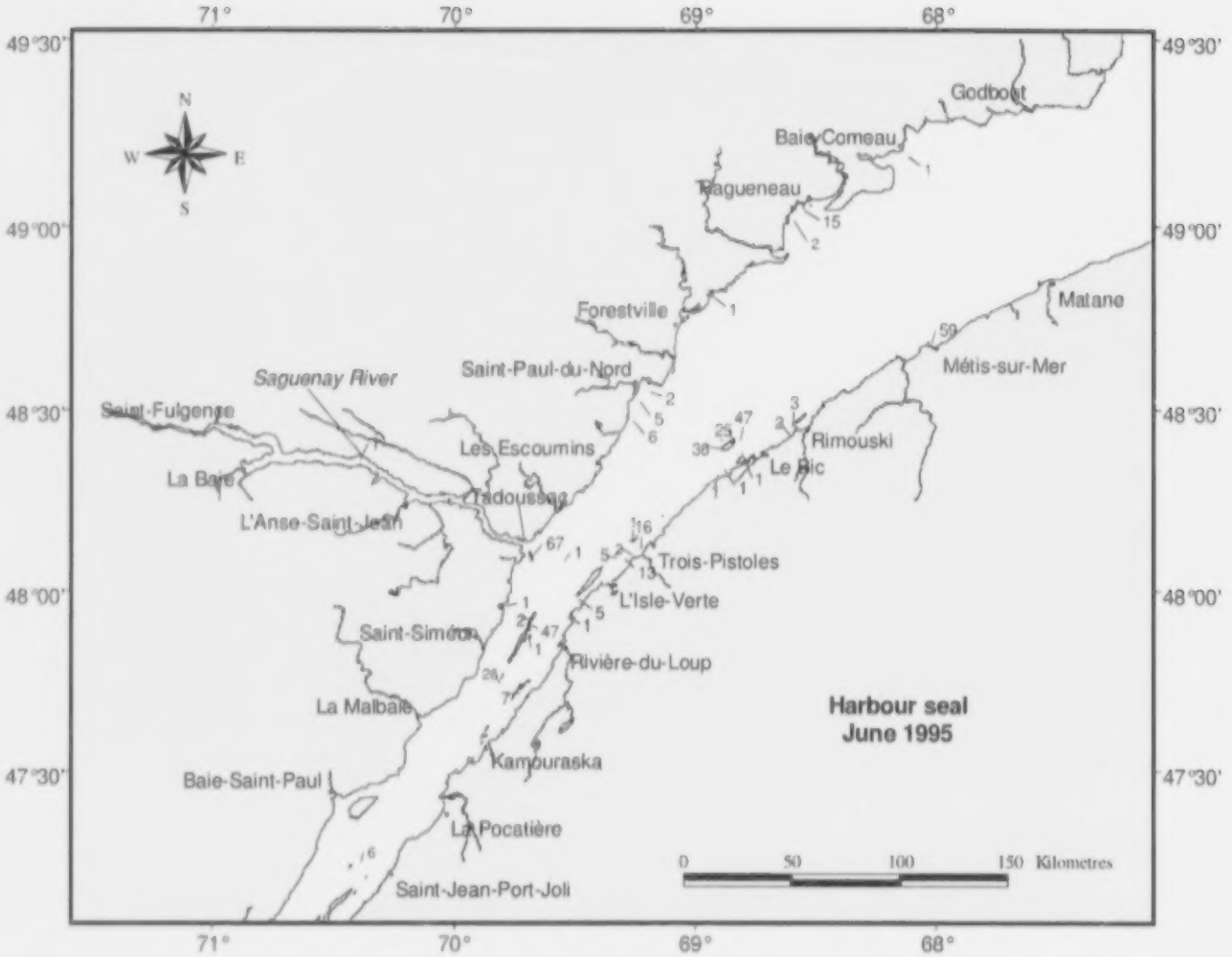
APPENDIX II.1

Harbour seals in the St. Lawrence Estuary and Saguenay River in 1994–2000

APPENDIX II.1.1

Harbour seal sightings in the St. Lawrence Estuary and Saguenay River, 1994–2000. Shaded areas represents sites exposed at low tide.

Distribution and abundance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Saguenay River
Saint-Paul-du-Nord
Saint-Fulgence
Métis-sur-Mer
Les Escoumins
Rimouski
La Baie
Le Bic
Tadoussac
L'Anse-Saint-Jean
Trois-Pistoles
L'Isle-Verte
Saint-Siméon
Rivière-du-Loup
La Malbaie
Harbour seal
June 1995
Kamouraska
Baie-Saint-Paul
La Pocatière
Saint-Jean-Port-Joli
0
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100
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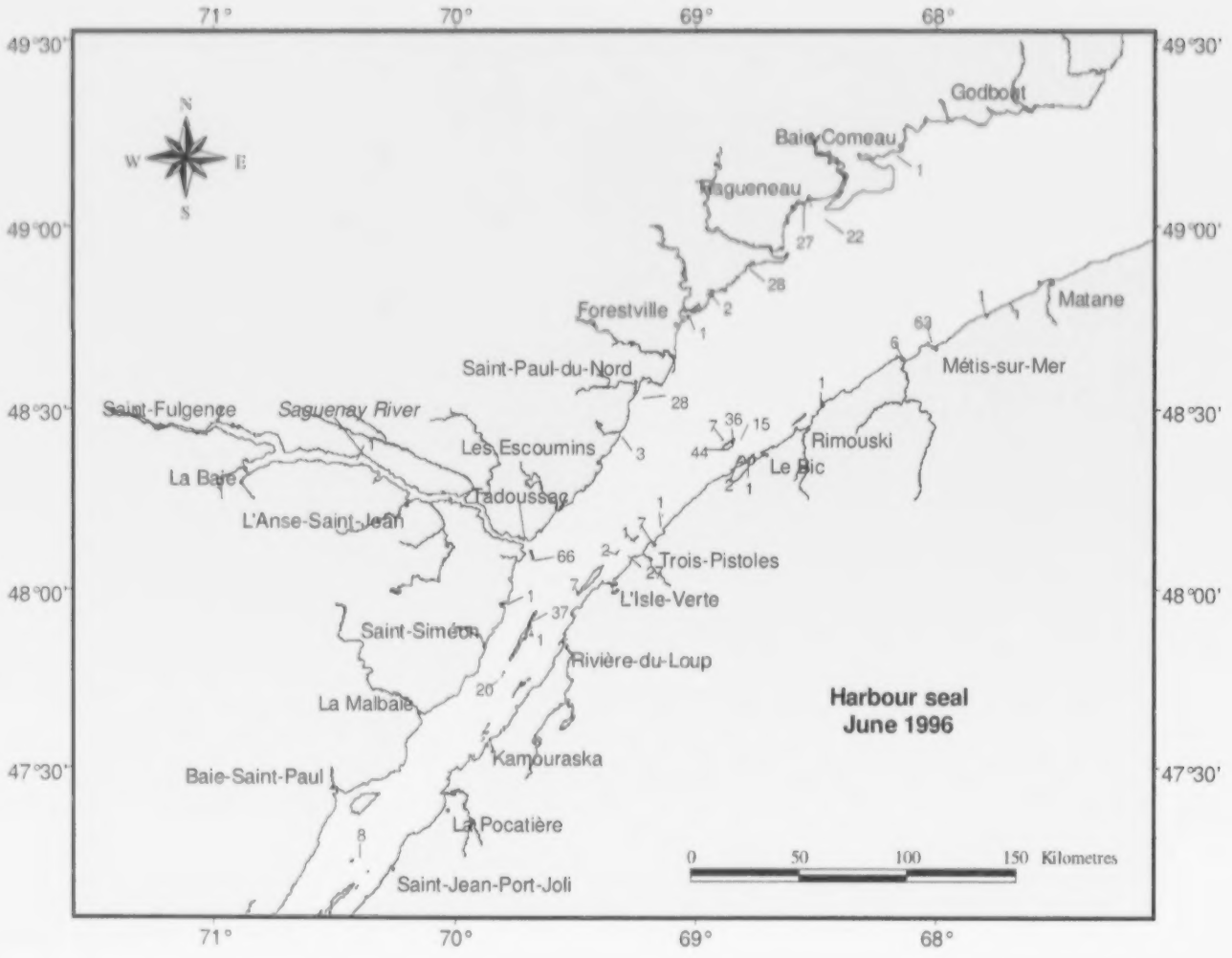
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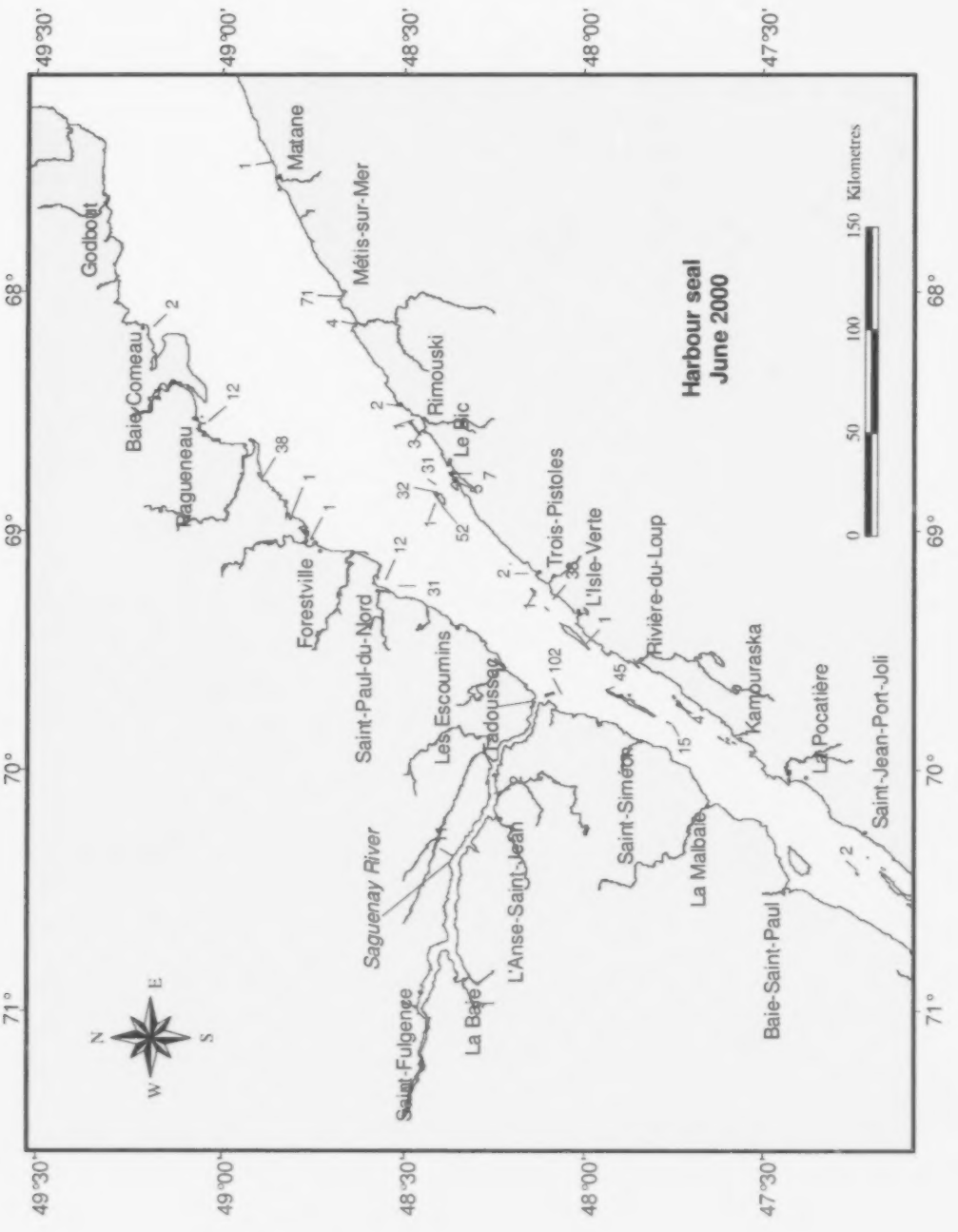
Saint-Paul-du-Nord
Métis-sur-Mer
Saint-Fulgence
Saguenay River
Les Escoumins
Rimouski
Le Bic
La Baie
Tadoussac
L'Anse-Saint-Jean
Trois-Pistoles
L'Isle-Verte
Saint-Siméon
Rivière-du-Loup
La Malbaie
Kamouraska
Baie-Saint-Paul
La Pocatière
Saint-Jean-Port-Joli
Harbour seal
June 1996
0 50 100 150 Kilometres


Harbour seal
June 2000
Godbout
Baie-Comeau
Hagueneau
Forestville
Saint-Paul-du-Nord
Les Escoumins
Tadoussac
L'Anse-Saint-Jean
La Baie
Saint-Fulgence
Saguenay River
Matane
Métis-sur-Mer
Rimouski
Le Bic
Trois-Pistoles
L'Isle-Verte
Rivière-du-Loup
Saint-Siméon
La Malbaie
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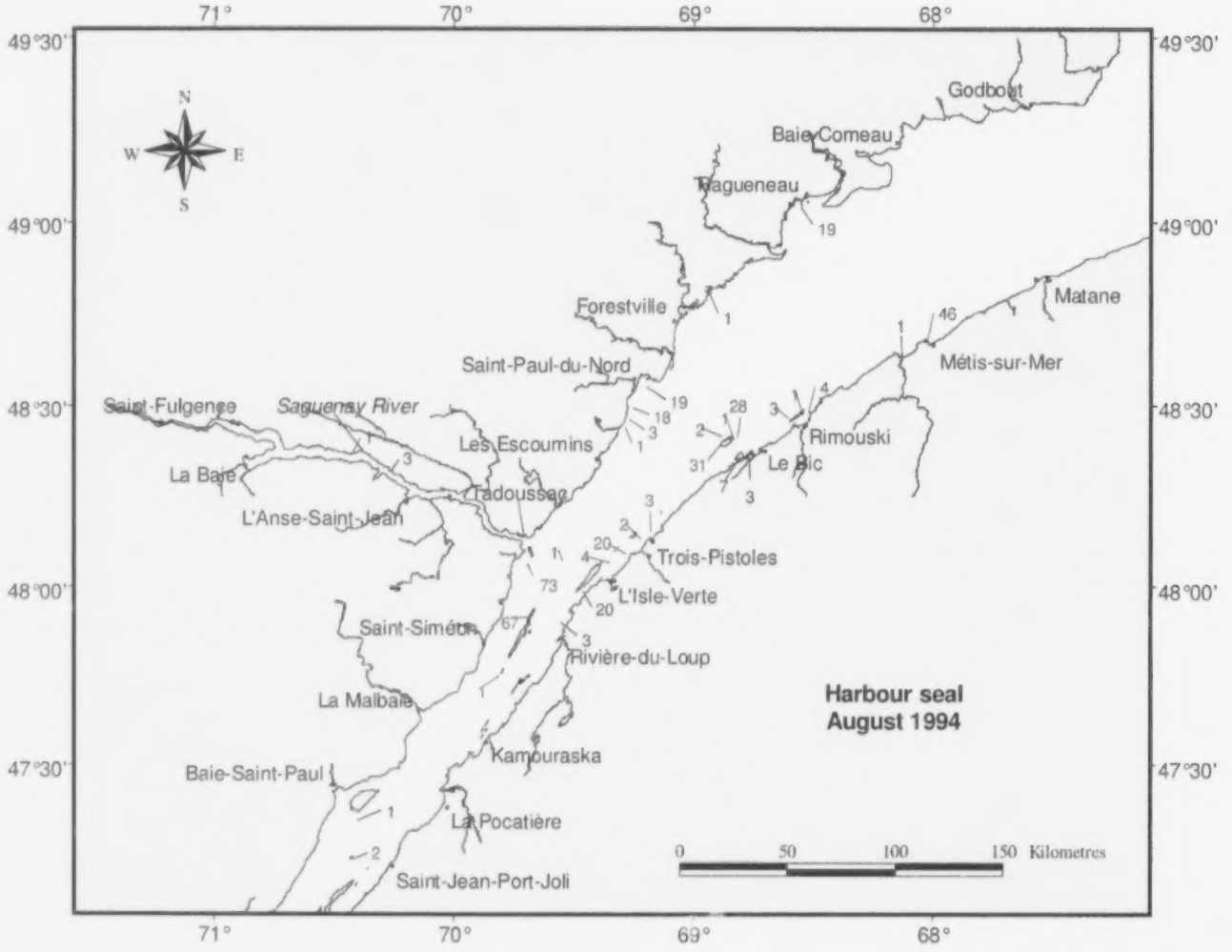
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Forestville
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Saint-Paul-du-Nord
Saint-Fulgence
Saguenay River
19
18
3
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28
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4
Rimouski
Les Escoumins
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Le Bic
3
La Baie
3
Tadoussac
L'Anse-Saint-Jean
3
2
1
4
20
Trois-Pistoles
73
L'Isle-Verte
20
Saint-Siméon
67
3
Rivière-du-Loup
La Malbaie
Harbour seal
August 1994
Kamouraska
Baie-Saint-Paul
1
La Pocatière
2
Saint-Jean-Port-Joli
0
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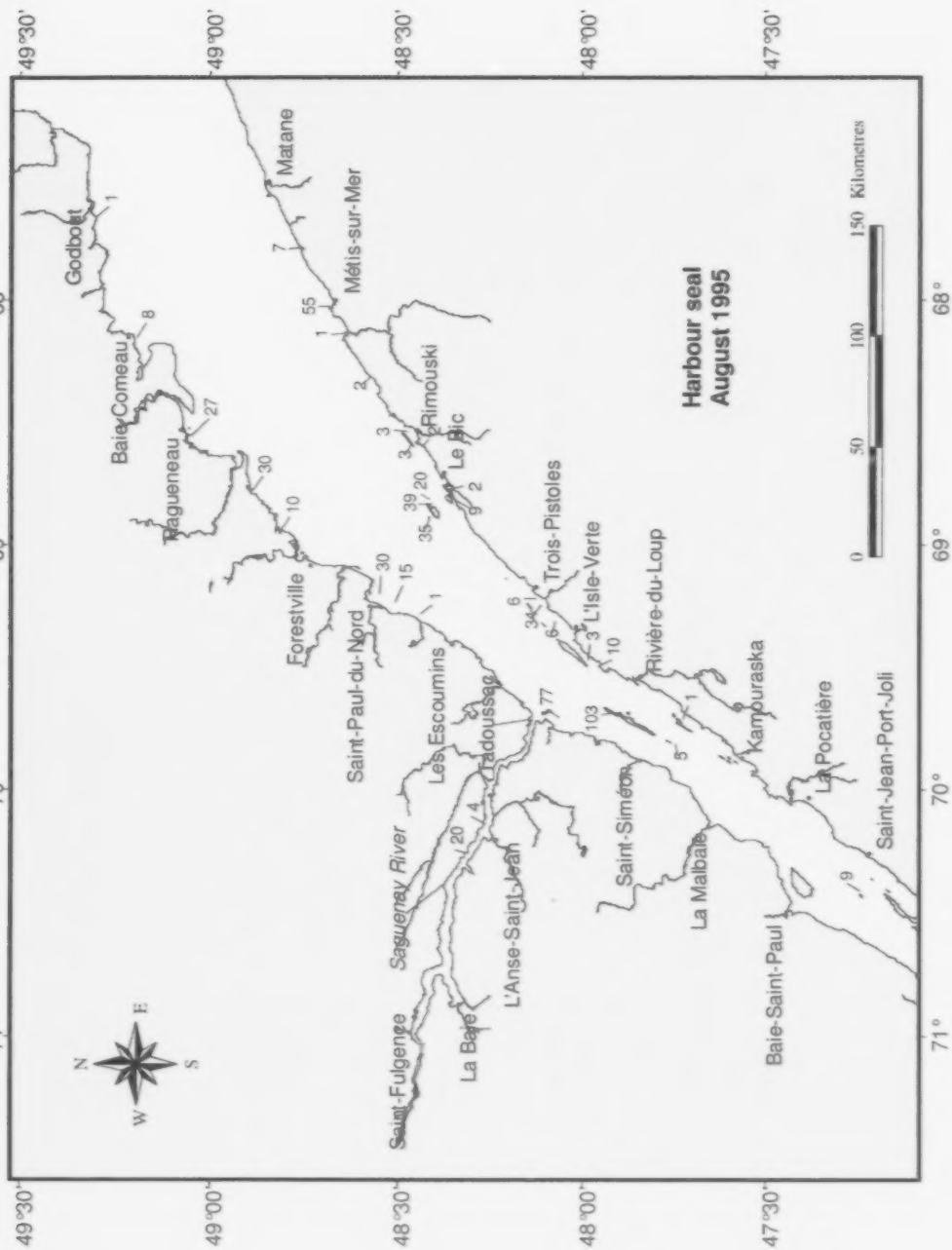
Harbour seal
August 1995
Godbout
Baie-Comeau
Hauteneau
Forestville
Saint-Paul-du-Nord
Les Escoumins
Tadoussac
L'Anse-Saint-Jean
La Baie
Saint-Fulgence
Saguenay River
Saint-Siméon
La Malbaie
Baie-Saint-Paul
Rivière-du-Loup
Trois-Pistoles
L'Isle-Verte
Kamouraska
La Pocatière
Saint-Jean-Port-Joli
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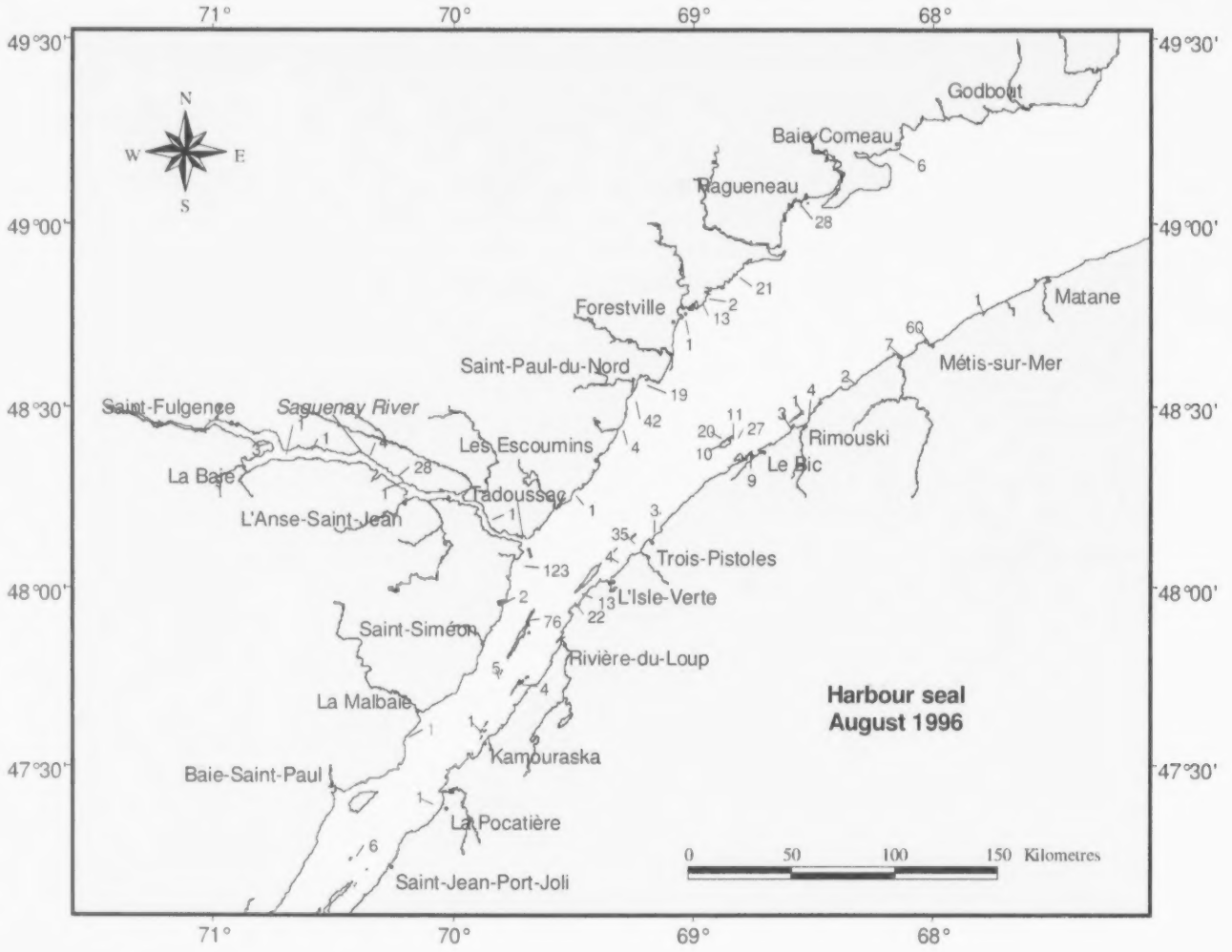
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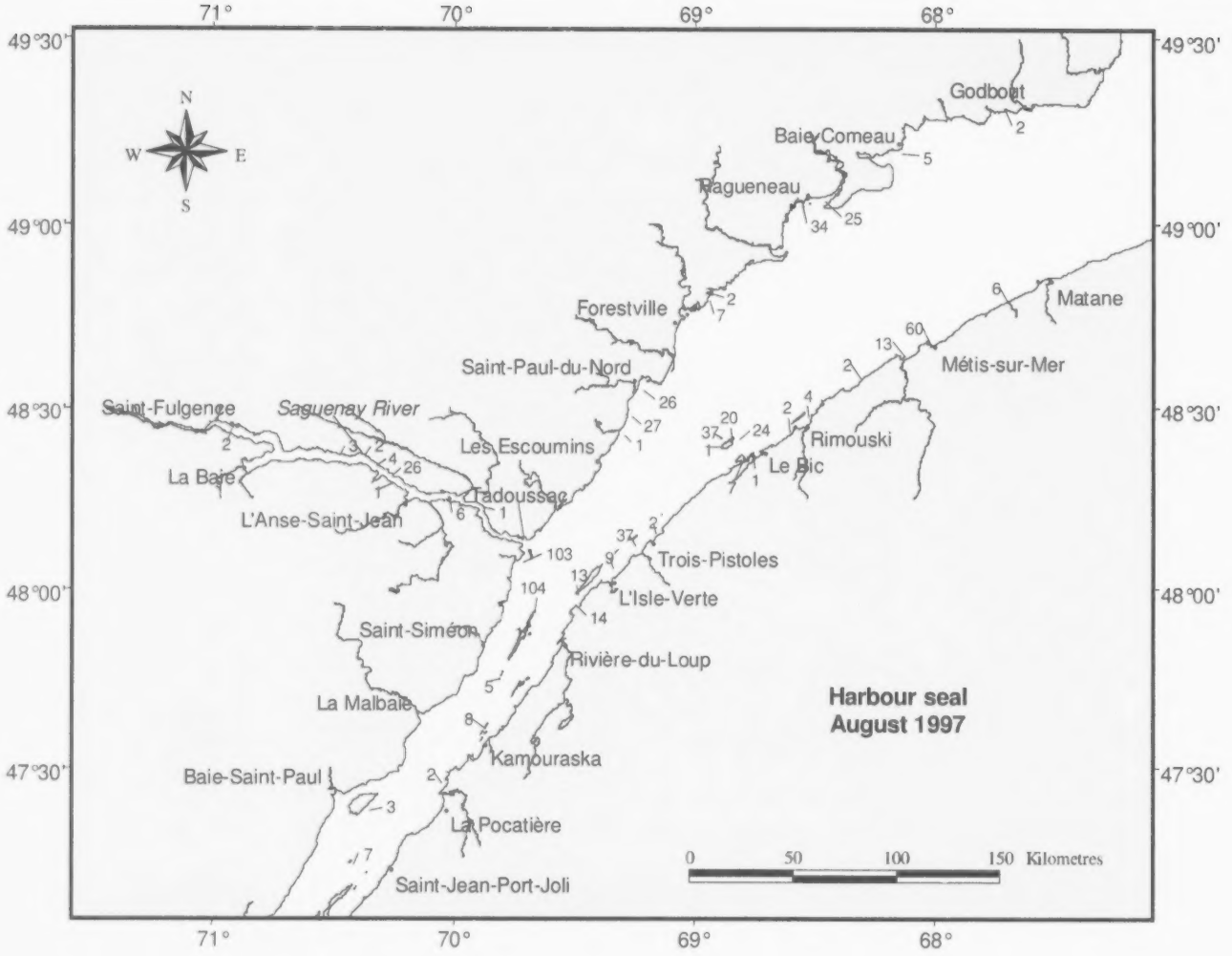
Métis-sur-Mer
Saint-Fulgence
Saguenay River
Les Escoumins
Rimouski
Le Bic
La Baie
Tadoussac
L'Anse-Saint-Jean
Trois-Pistoles
L'Isle-Verte
Saint-Siméon
Rivière-du-Loup
La Malbaie
Kamouraska
Baie-Saint-Paul
La Pocatière
Saint-Jean-Port-Joli
Harbour seal
August 1996
0 50 100 150 Kilometres


71°
70°
69°
68°
49°30'
49°00'
48°30'
48°00'
47°30'
N
W
E
S
Godbout
2
Baie-Comeau
5
Ragueneau
34
25
Forestville
2
7
Matane
6
60
13
Métis-sur-Mer
2
Saint-Paul-du-Nord
26
27
1
Saint-Fulgence
Saguenay River
2
3
2
4
26
Les Escoumins
37
20
24
2
4
Rimouski
1
Le Bic
La Baie
1
Tadoussac
6
1
L'Anse-Saint-Jean
37
2
103
9
Trois-Pistoles
13
104
L'Isle-Verte
14
Saint-Siméon
Rivière-du-Loup
5
La Malbaie
8
Kamouraska
Baie-Saint-Paul
2
3
La Pocatière
7
Saint-Jean-Port-Joli
Harbour seal
August 1997
0
50
100
150
Kilometres

APPENDIX II.1.2

Harbour seal sightings in the St. Lawrence Estuary and Saguenay River, 1994–2000

Number of individuals observed at each haul-out site during each survey with associated haul-out substrate. Map, zone, site IDs, and number of sightings in the table refer to material presented in appendices II.1.1 and II.1.3

Appendix. II.1.2

Map ID	Zone ID	Site ID	Area	June			August				Substrate
				1995	1996	2000	1994	1995	1996	1997	
1	1	1	East of Matane	0	0	1	0	0	0	0	ir
1	1	2	Saint-Ulric-de-Matane	0	0	0	0	0	0	6	ir
1	2	3	Pointe au Naufrage	0	1	0	0	7	1	0	ir
2	3	4	Reef 12 Pointe Mitis	12	17	14	4	0	5	30	ir
2	3	5	Reef 7 Pointe Mitis	0	13	2	41	48	37	0	r
2	3	6	Reef 3 Pointe Mitis	22	1	0	1	5	18	1	r
2	3	7	West of Pointe Mitis	25	32	55	0	2	0	29	r
2	4	8	Baie Mitis	0	6	4	1	1	7	13	ir, r
3	5	9	Sainte-Luce	0	0	0	0	2	2	2	ir
4	6	10	Wharf of Pointe-au-Père	0	1	2	0	0	0	0	ir
5	7	11	Marina of Rimouski	0	0	0	4	3	4	4	ir
5	7	12	S of E point of Île Saint-Barnabé	0	0	1	1	0	1	0	ir
5	7	13	S of W point of Île Saint-Barnabé	3	0	3	3	3	0	0	ir
5	7	14	SW of Îlet Canuel	2	0	0	0	2	3	2	ir
6	8	15	Bay NE of Cap Enragé	0	1	7	3	2	9	1	ir
6	8	16	Anse à l'Orignal	0	0	0	0	9	0	7	ir
6	8	17	Bay of Cap à l'Orignal	0	0	0	7	0	0	0	ir
6	8	18	Récif de l'Orignal	1	2	5	0	0	0	0	r
6	9	19	Anse à Mercier	2	0	0	0	0	0	0	r
7	8	20	Récif du Sud-Est	47	15	31	28	20	27	24	r
7	8	21	South of Grande Anse	25	3	32	0	0	0	1	r, ir , sb, b
7	8	22	Grande Anse	0	0	0	1	13	0	5	ir
7	8	23	Récif du Nord-Est	0	33	0	0	26	11	14	r
7	8	24	Île Bicquette	0	0	1	2	0	20	37	r
7	8	25	Récif du Nord-Ouest	0	7	0	0	0	0	0	r
7	8	26	Récif de l'Ouest	0	0	0	0	35	0	0	r
7	8	27	NW of Île du Bic	1	0	1	0	0	0	0	ir
7	8	28	NW reef of W point of Île du Bic	19	10	24	10	0	0	0	r
7	8	29	W point of Île du Bic	16	34	27	21	0	10	1	r
8	11	30	Between Razade d'en Haut et d'en Bas	0	1	0	0	0	0	0	r
8	10	31	Anse des Riou	16	7	2	3	0	3	2	ir

ir = isolated rocks; r= reefs; sb = sand banks; cl = rocks at the bottom of a cliff; b = beaches

Appendix II.1.2. (Continued)

Map ID	Zone ID	Site ID	Area	June			August				Substrate
				1995	1996	2000	1994	1995	1996	1997	
8	11	32	E point of Île aux Basques	1	0	0	0	0	0	0	ir
8	11	33	W point of Île aux Basques	2	1	1	0	0	0	0	sb
8	13	34	Batture de Tobin and de l'Île Ronde	14	27	38	22	46	39	37	ir
8	12	35	E point of Île aux Pommes	2	1	0	0	0	0	0	ir
8	12	36	West point of Île aux Pommes	3	1	0	0	0	0	0	ir
9	13	37	NE point of Île Verte	0	0	0	4	0	0	9	ir
9	14	38	Channel of Île Verte	0	0	1	20	13	35	14	ir
9	14	39	SW point of Île Verte	5	7	0	0	0	0	13	ir
9	15	40	Île Rouge	1	0	0	1	0	0	0	ir
10	16	41	NE point of Rocher Percé	1	0	0	3	0	0	0	ir
10	17	42	SE side of Île Blanche	0	0	0	1	0	0	0	ir, r
10	17	43	N side of Île Blanche	2	0	0	0	15	0	0	ir, r
10	17	44	Île Blanche	47	37	45	66	88	76	104	ir
10	18	45	NE point of Île aux Lièvres	0	1	0	0	0	0	0	ir
10	18	46	Îles du Pot à l'Eau-de-Vie	1	0	0	0	0	0	0	ir
10	18	47	N of Île aux Lièvres	0	0	0	0	0	0	1	ir
11	19	48	Île aux Fraises	26	20	15	1	5	5	5	r
11	20	49	Les Pélerins	7	0	4	0	0	0	0	r
11	20	50	Battures de Rivière-du-Loup close to Les Pélerins	0	0	0	0	1	4	0	ir
12	21	51	W of Île aux Corneilles	0	0	0	0	0	0	8	sb
12	21	52	Îlot Julien	0	0	0	0	0	1	0	ir
12	22	53	Anse Saint-Anne	0	0	0	0	0	0	2	ir
12	22	54	Sainte-Anne-de-la-Pocatière	0	0	0	0	0	1	0	ir
12	25	55	Saint-Irénée	0	0	0	0	0	1	0	ir
13	23	56	NE pt of Battures aux Loups Marins	0	8	0	2	9	0	0	ir
13	23	57	Channel of Battures aux Loups Marins	5	0	2	0	0	6	7	ir
13	23	58	SW Pt of Battures aux Loups Marins	1	0	0	0	0	0	0	ir
13	24	59	SW point of Île aux Coudres	0	0	0	1	0	0	0	ir
13	24	60	S side of Île aux Coudres	0	0	0	0	0	0	3	ir
14	26	61	Baie des Rochers	1	1	0	0	0	2	0	ir
15	27	62	Batture aux Alouettes	67	66	102	73	77	123	103	ir, r
16	28	63	Batture à Théophile	0	0	0	0	0	1	0	ir

ir = isolated rocks; r= reefs; sb = sand banks; cl = rocks at the bottom of a cliff; b = beaches

Appendix II.1.2. (Continued)

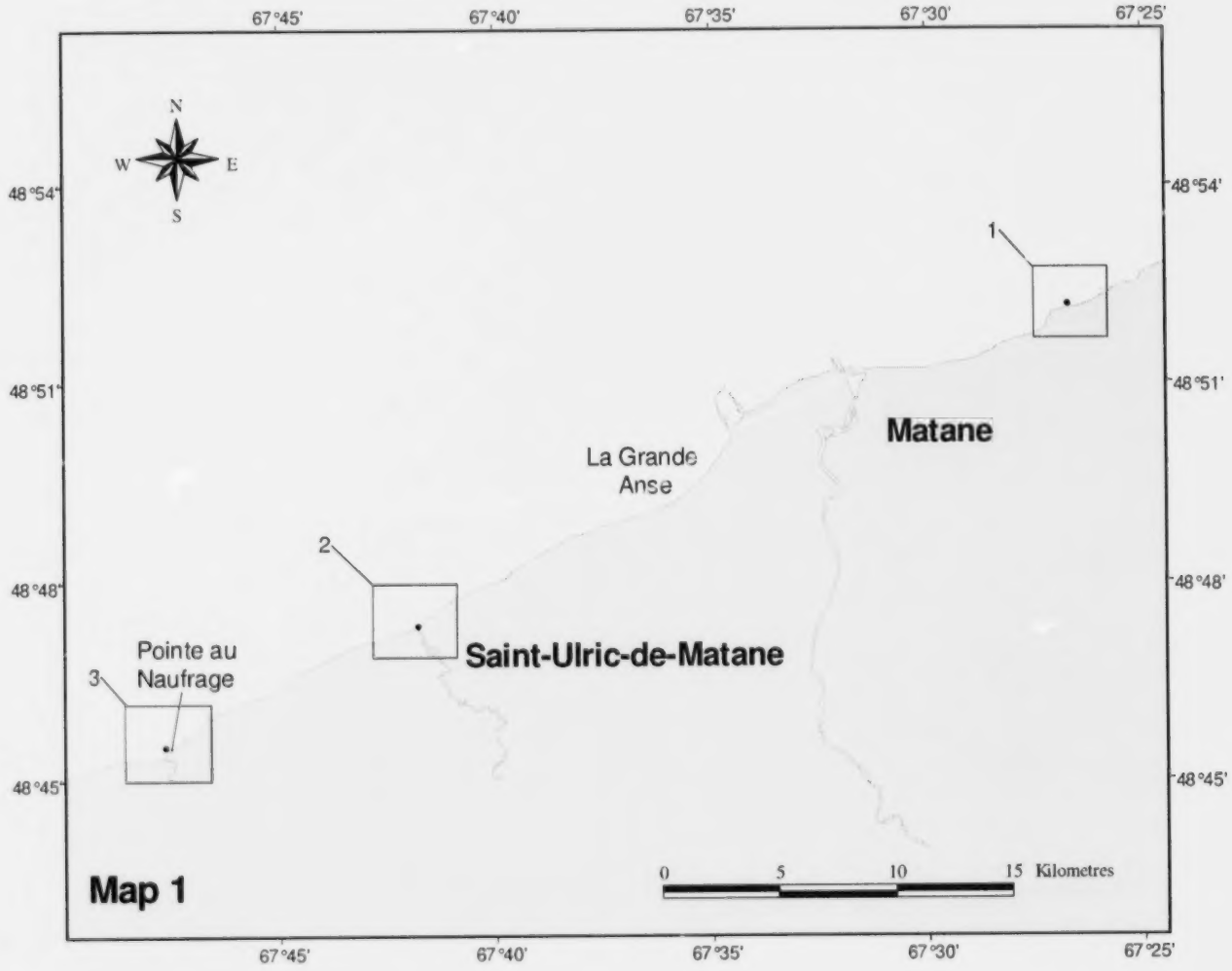
Map ID	Zone ID	Site ID	Area	June			August				Substrate
				1995	1996	2000	1994	1995	1996	1997	
17	29	64	Hauts-fonds de Mille-Vaches- W of St-Paul-du-Nord	6	8	0	22	16	4	28	ir
17	29	65	Hauts-fonds de Mille-Vaches- S of St-Paul-du-Nord	5	23	43	19	0	61	26	ir
17	29	66	Pointe à Boisvert	2	0	0	0	30	0	0	ir
18	30	67	West of Forestville	0	0	1	0	0	0	0	ir
18	30	68	Baie Laval	0	1	0	0	0	1	0	ir
18	31	69	Battures aux Gibiers	1	2	0	0	10	13	7	ir
18	31	70	Baie Blanche	0	0	1	1	0	2	2	ir
19	32	71	Îlets Jérémie	0	28	38	0	30	21	0	r
20	33	72	Point of l'Anse des Aulnes	2	0	0	0	0	0	0	r
20	33	73	Pointe-aux-Outardes	0	22	0	0	0	0	0	sb
20	33	74	Île de la Mine	15	27	12	19	27	28	34	r
20	33	75	River mouth at Pointe-aux-Outardes	0	0	0	0	0	0	25	sb
21	34	76	Pointe Saint-Gilles	1	1	2	0	8	6	5	sb
22	35	77	Pointe Rouge	0	0	0	0	1	0	2	ir
23	36	78	~ 2 km donwstream of Anse Creuse	0	0	0	0	0	1	0	cl
23	36	79	Anse de Roche	0	0	0	0	0	0	1	ir
24	36	80	~ 2.5 km upstream of Île Saint-Louis	0	0	0	0	0	0	6	cl, ir
24	36	81	Between L'Anse-Saint-Jean and Anse du Petit Saguenay	0	0	2	0	0	0	0	ir
24	36	82	~ 2 km downstream of l'Anse du Portage	0	0	0	0	4	0	0	cl
25	37	83	~ 4 km downstream of Cap Éternité	0	0	0	0	0	1	1	cl
25	37	84	Between Cap Fraternité and Cap Égalité	0	0	0	3	20	28	26	cl
25	37	85	Opposite shore in front of Cap Trinité	0	0	0	0	0	0	1	cl
25	37	86	~ 1 km downstream of Ruisseau Biscambi	0	0	0	0	0	0	3	cl
25	37	87	Pointe Trinité	0	0	0	0	0	1	2	cl
25	37	88	Baie de la Trinité	0	0	9	0	0	2	0	ir
25	37	89	~ 2 km downstream of Saint-Basile-de-Tableau	1	0	2	1	0	1	0	ir
25	37	90	~ 3 km upstream of Saint-Basile-de-Tableau	0	1	0	0	0	0	0	ir
26	37	91	~ 4.5 km downstream of Cap Rouge	0	0	0	0	0	0	3	ir
26	38	92	Anse du Sable	0	0	0	0	0	1	0	cl
27	38	93	South of Cap de l'Ouest	0	0	0	0	0	1	0	cl
27	38	94	Upstream of Grande Anse wharf	0	0	0	0	0	3	0	cl
27	38	95	Upstream of Maltais wharf	0	0	0	0	0	0	2	ir

ir = isolated rocks; r= reefs; sb = sand banks; cl = rocks at the bottom of a cliff; b = beaches

APPENDIX II.1.3

Harbour seal sightings in the St. Lawrence Estuary and Saguenay River, 1994–2000

Location of harbour seal sightings (dots). The numbers associated with each haul-out area (rectangles) refer to site ID numbers at Appendix II.1.2, where the number of individuals observed at each site and for each survey is presented. Areas where haul-out sites are more spread out, often as a series of isolated rocks or small reefs, are indicated with dashed lines. The paler shaded zones represent areas exposed at low tide.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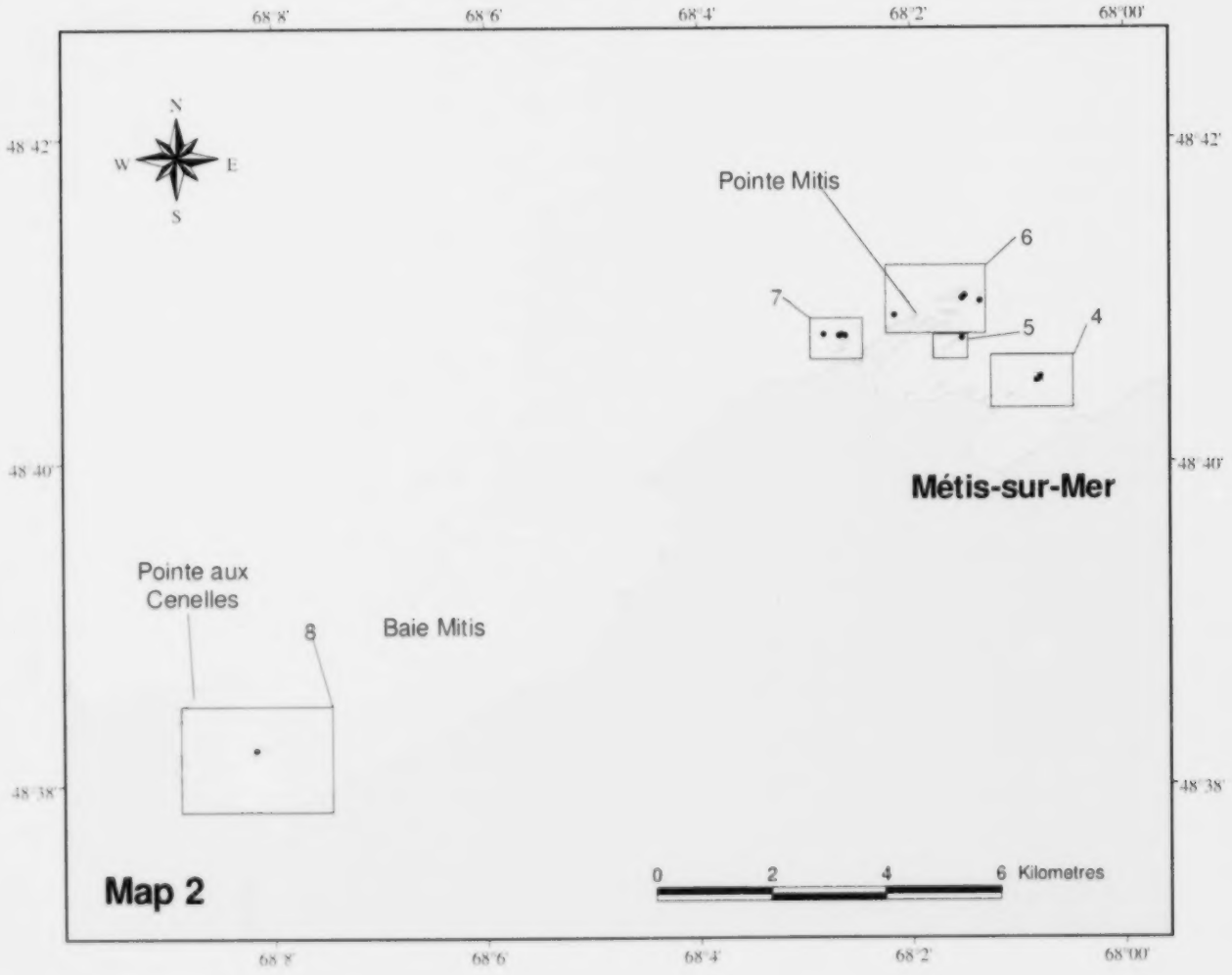
67°40'
67°35'
67°30'
67°25'
N
W
E
S
48°54'
48°51'
48°48'
48°45'
1
2
3
Matane
La Grande
Anse
Saint-Ulric-de-Matane
Pointe au
Naufrage
0
5
10
15 Kilometres

Map 1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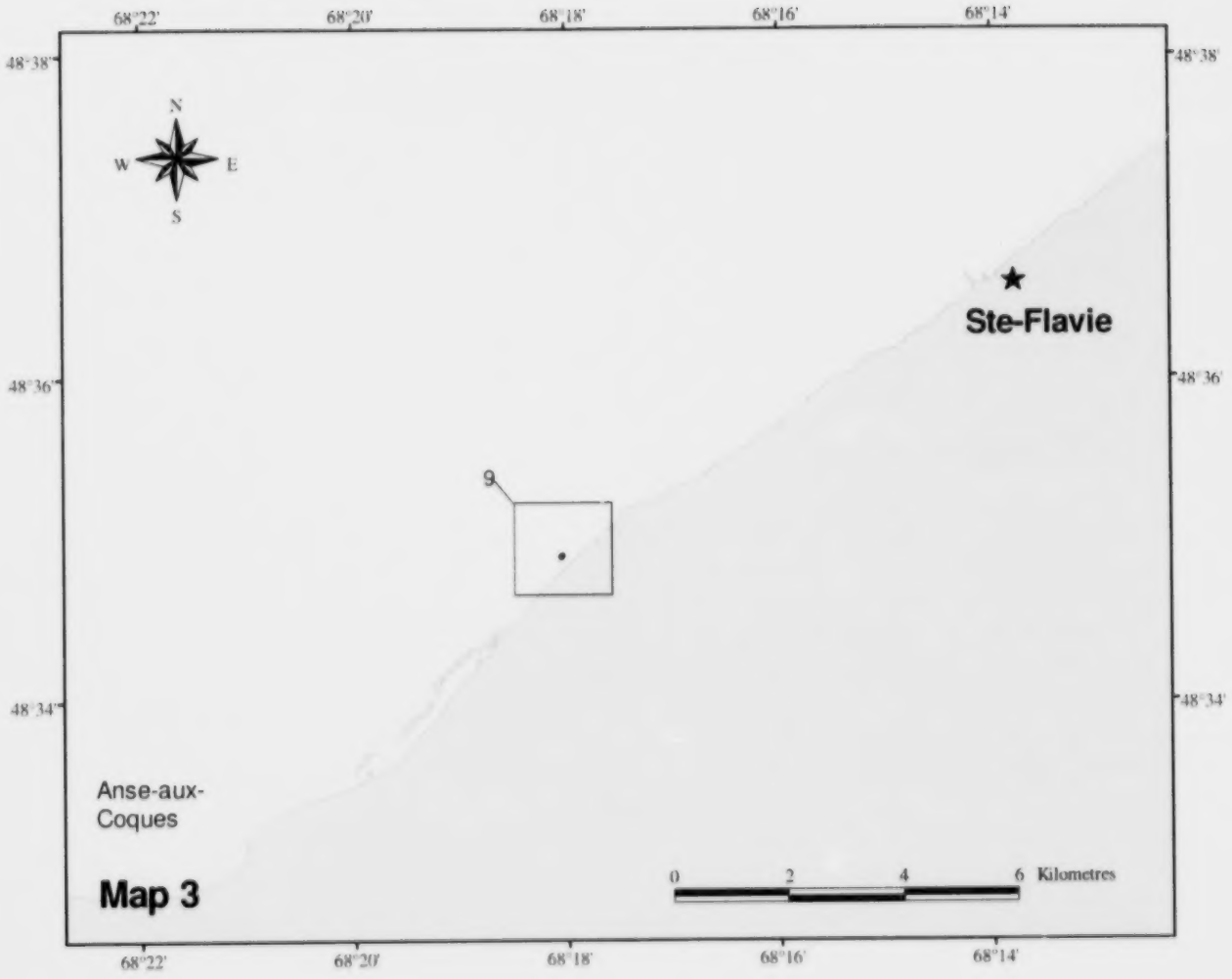
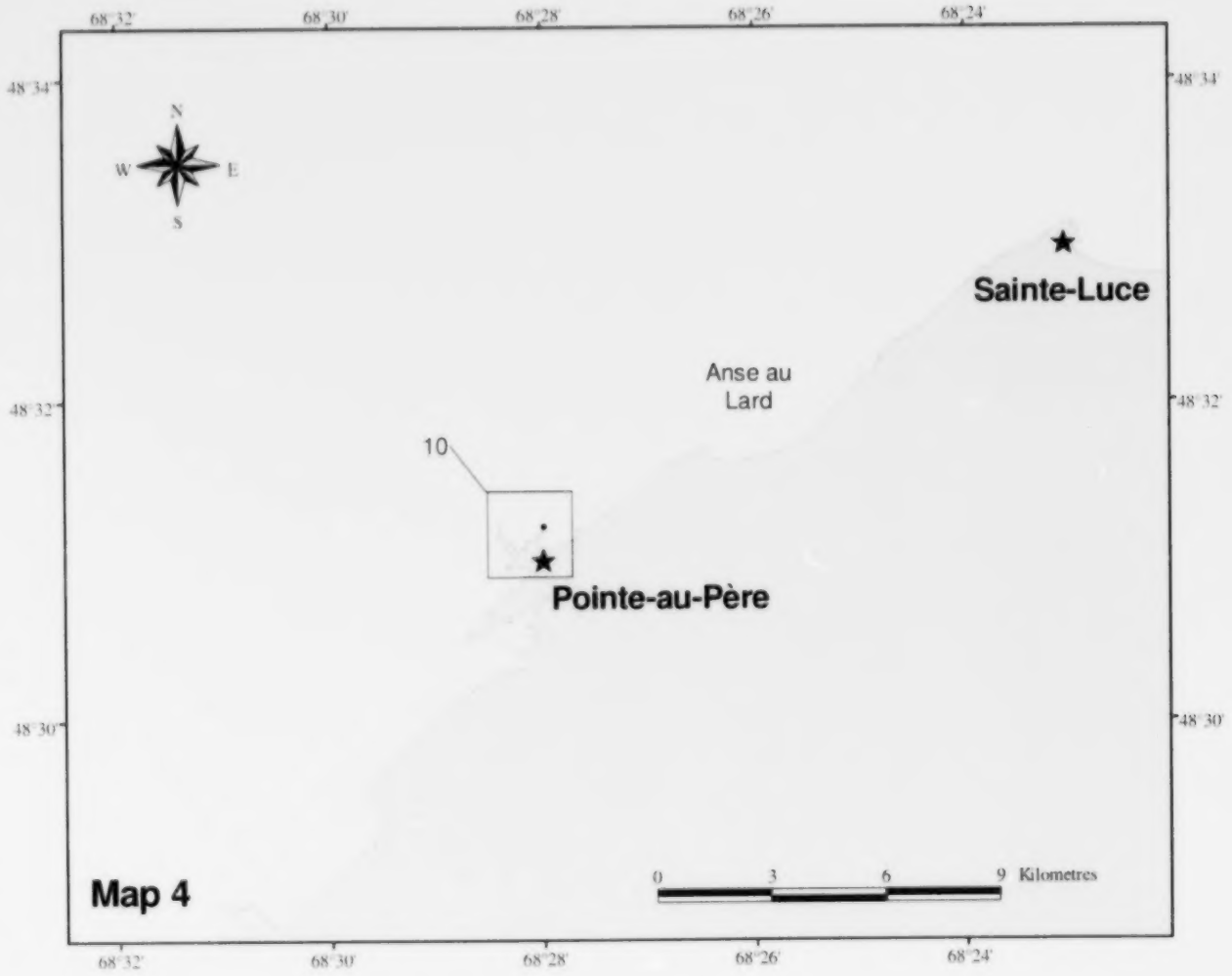
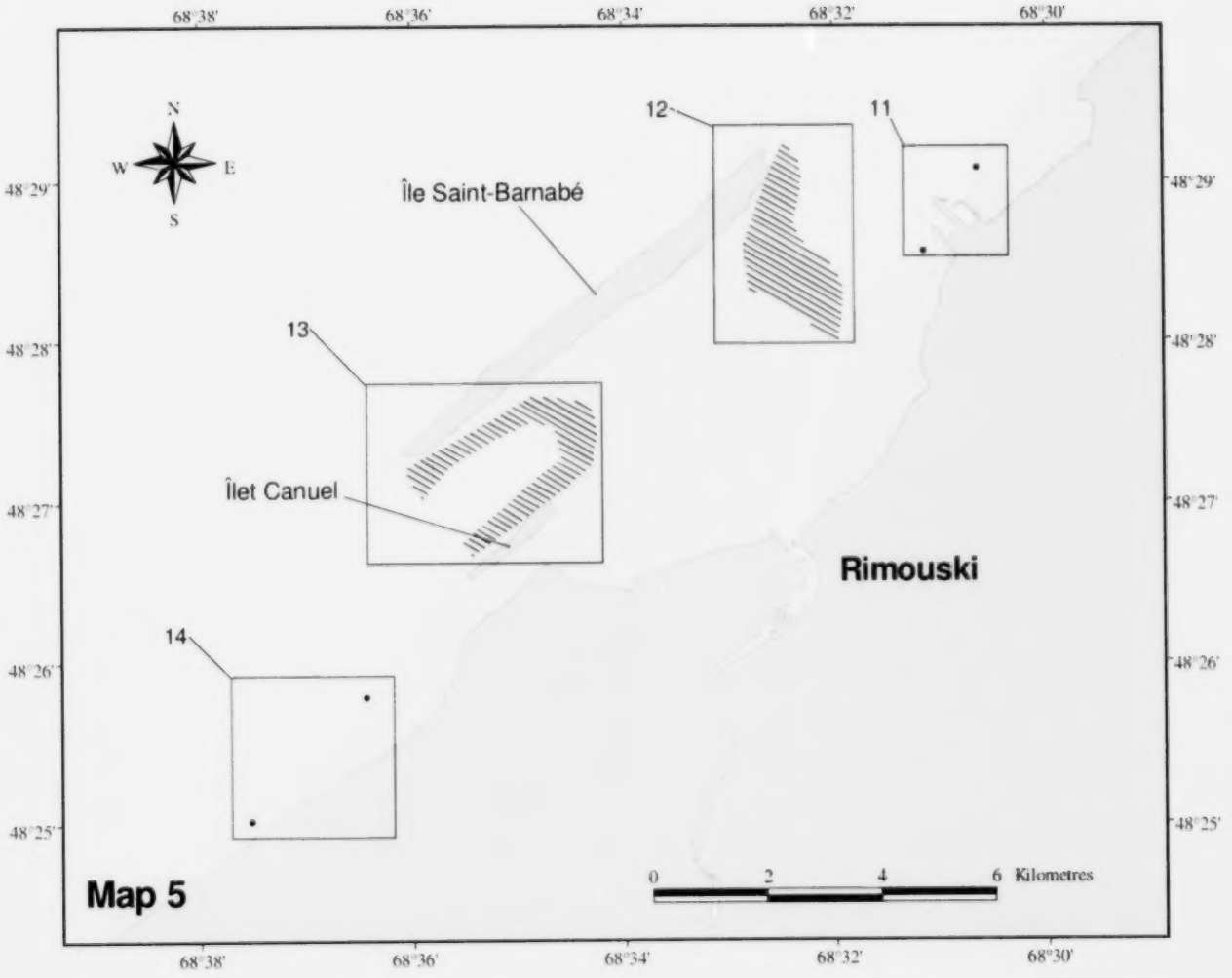
68°6'
68°4'
68°2'
68°00'
48°42'
48°40'
48°38'
N
W
E
S
Pointe Mitis
6
7
5
4
Métis-sur-Mer
Pointe aux
Cenelles
8
Baie Mitis
Map 2
0
2
4
6 Kilometres


68°22'
68°20'
68°18'
68°16'
68°14'
48°38'
48°36'
48°34'
N
W
E
S
Ste-Flavie
9
Anse-aux-
Coques
Map 3
0
2
4
6 Kilometres


68°32'
68°30'
68°28'
68°26'
68°24'
48°34'
48°32'
48°30'
N
W
E
S
Sainte-Luce
Anse au
Lard
10
Pointe-au-Père
0
3
6
9 Kilometres
Map 4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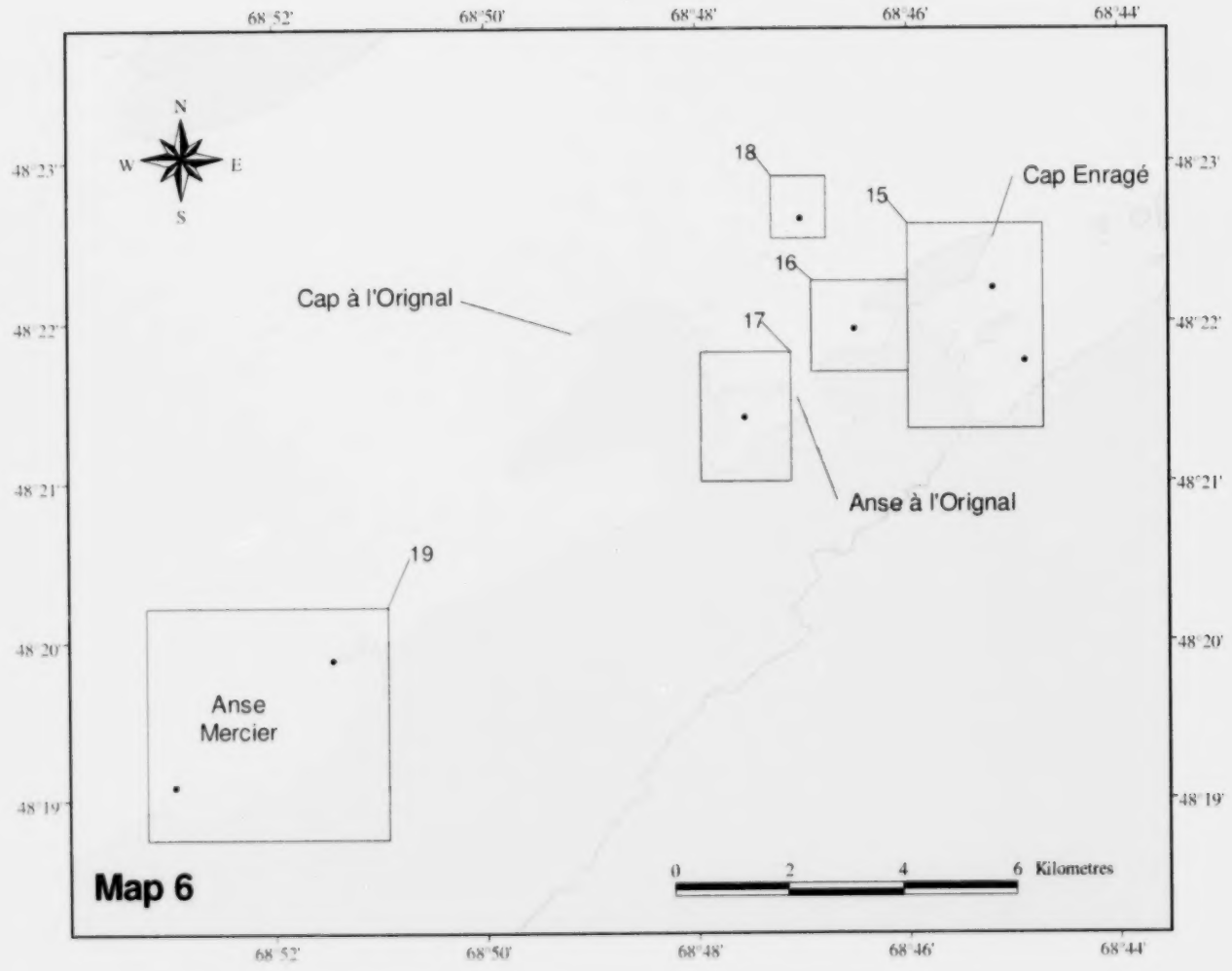
68°36'
68°34'
68°32'
68°30'
N
W
E
S
48°29'
48°28'
48°27'
48°26'
48°25'
12
11
Île Saint-Barnabé
13
Îlet Canuel
Rimouski
14
0
2
4
6 Kilometres

Map 5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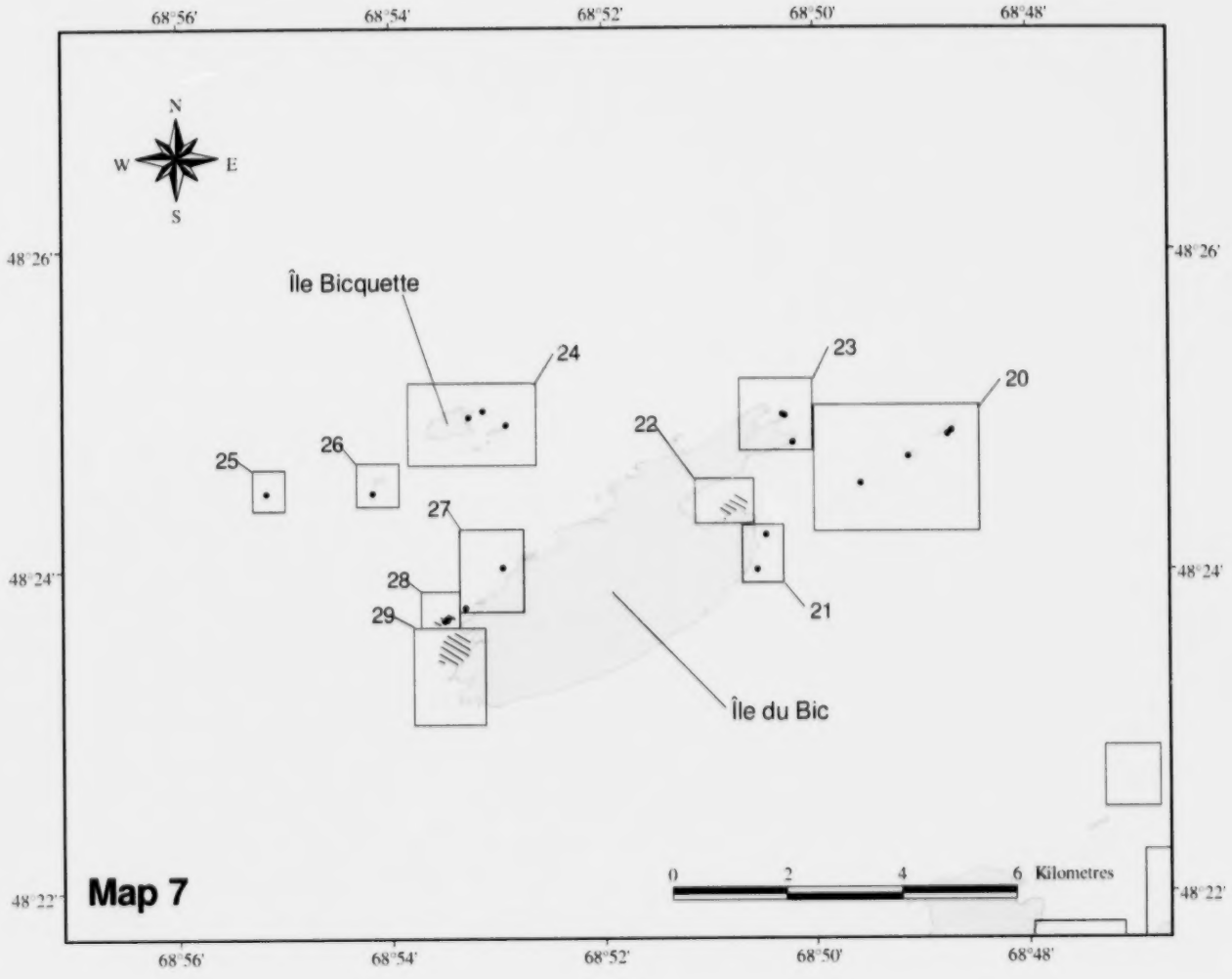
68°50'
68°48'
68°46'
68°44'
N
W
E
S
48°23'
48°22'
48°21'
48°20'
48°19'
18
15
Cap Enragé
16
Cap à l'Orignal
17
Anse à l'Orignal
19
Anse
Mercier
0
2
4
6 Kilometres

Map 6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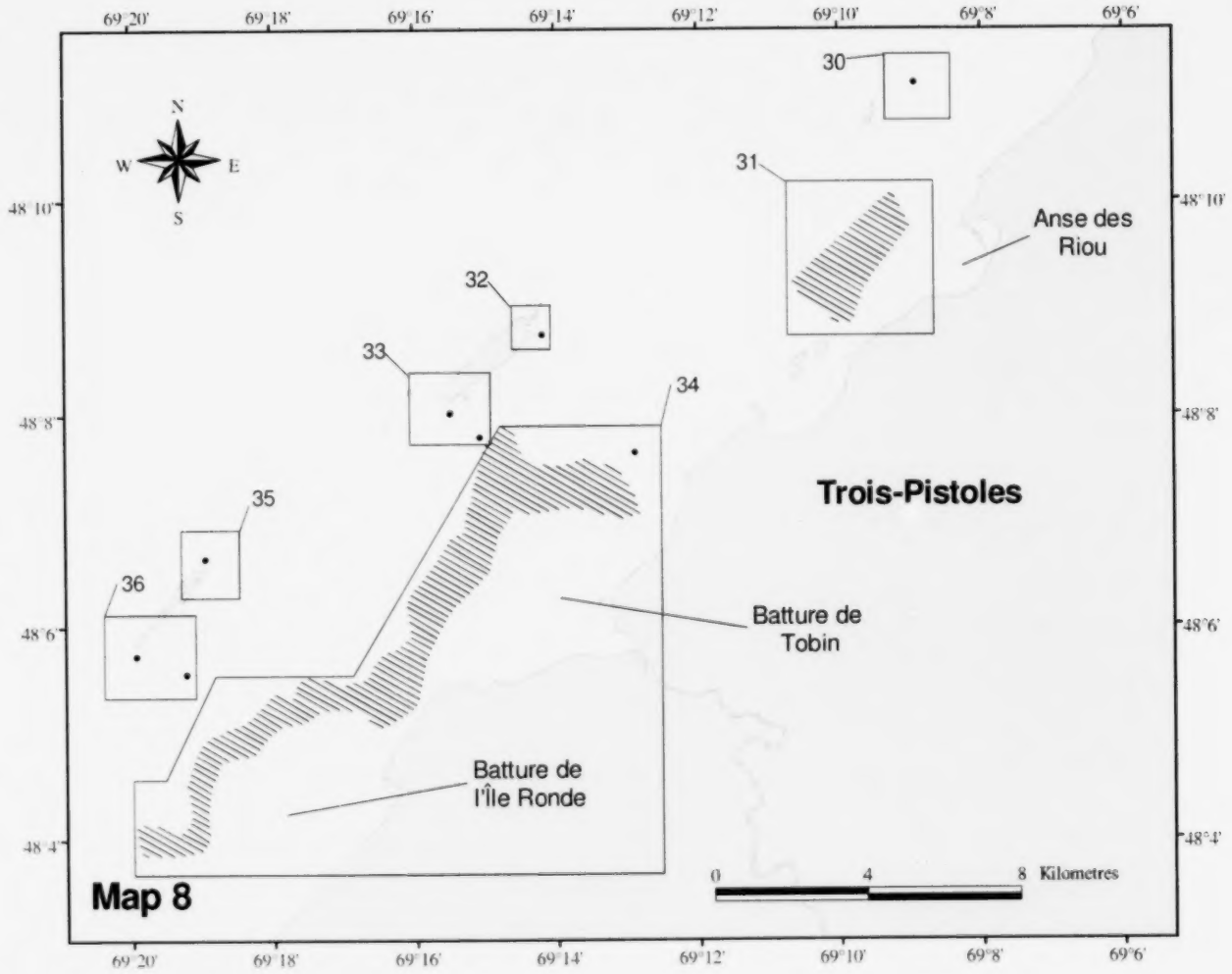
68°54'
68°52'
68°50'
68°48'
N
W
E
S
48°26'
48°24'
48°22'
Île Bicquette
24
23
20
22
26
25
27
28
29
21
Île du Bic
0
2
4
6 Kilometres

Map 7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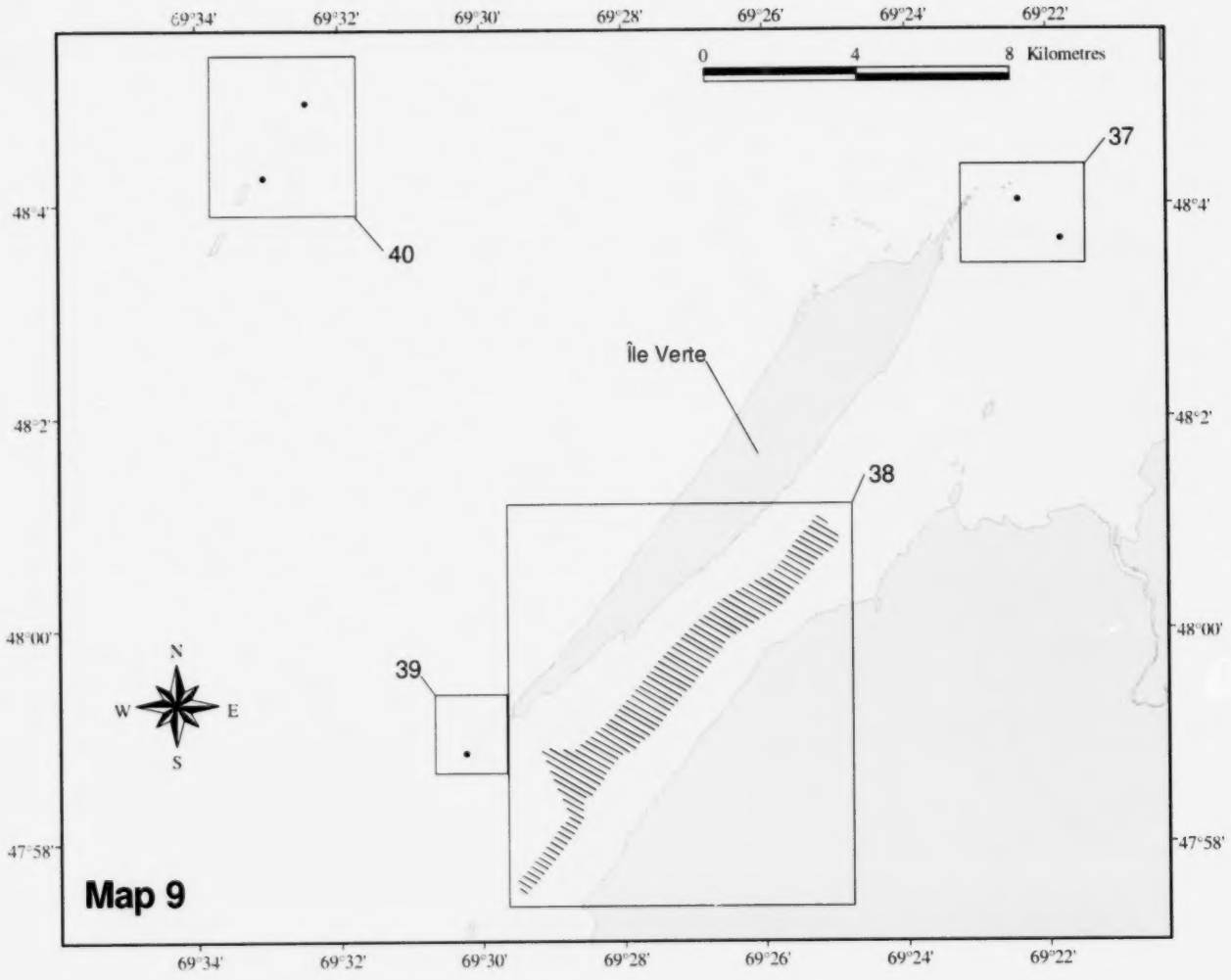
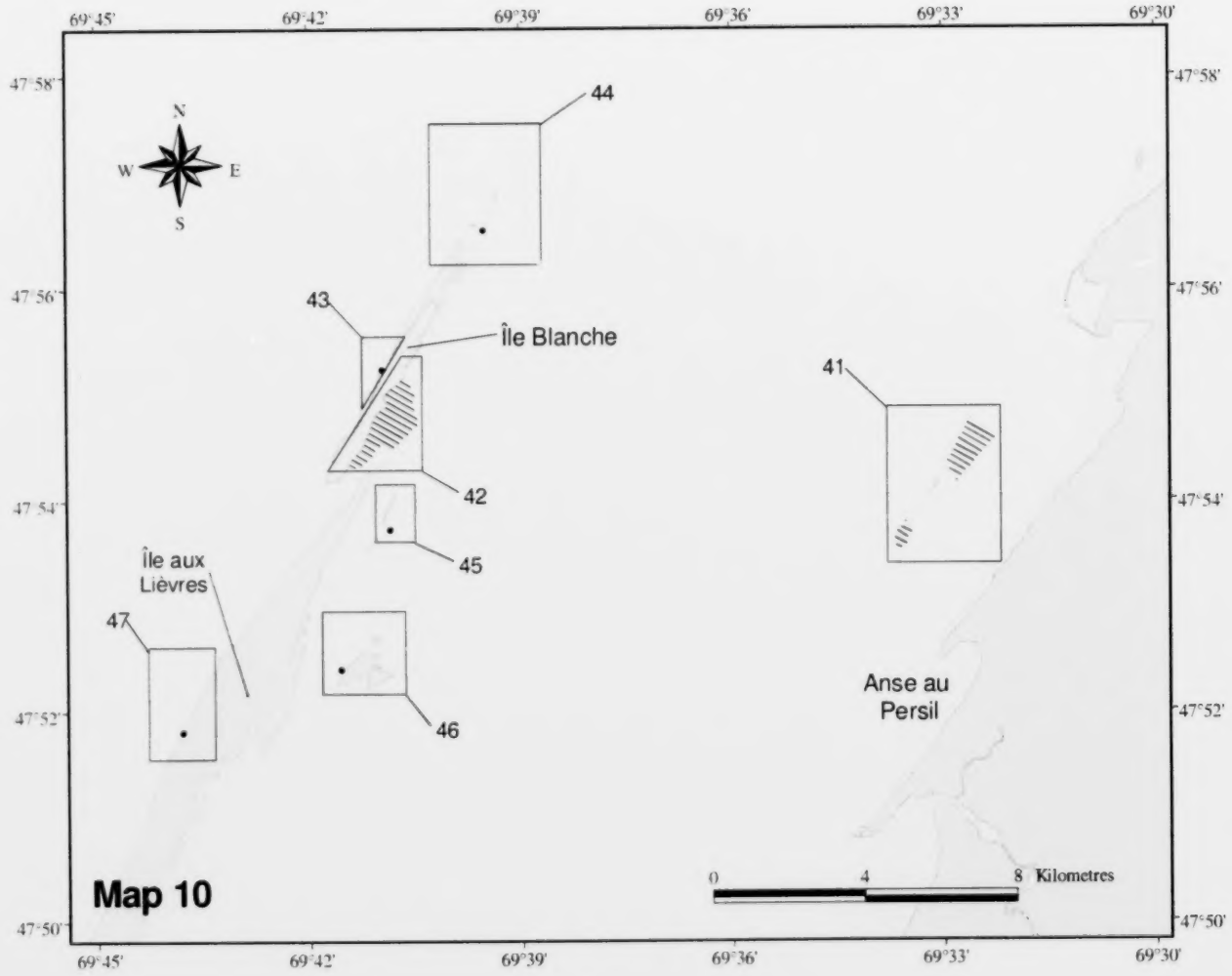
69°18'
69°16'
69°14'
69°12'
69°10'
69°8'
69°6'
48°10'
48°8'
48°6'
48°4'
N
W
E
S
30
31
Anse des
Riou
32
33
34
35
36
Trois-Pistoles
Batture de
Tobin
Batture de
l'Île Ronde
0
4
8 Kilometres

Map 8


69°34'
69°32'
69°30'
69°28'
69°26'
69°24'
69°22'
0
4
8 Kilometres
37
40
48°4'
Île Verte
48°2'
38
39
48°00'
N
W
E
S
47°58'
Map 9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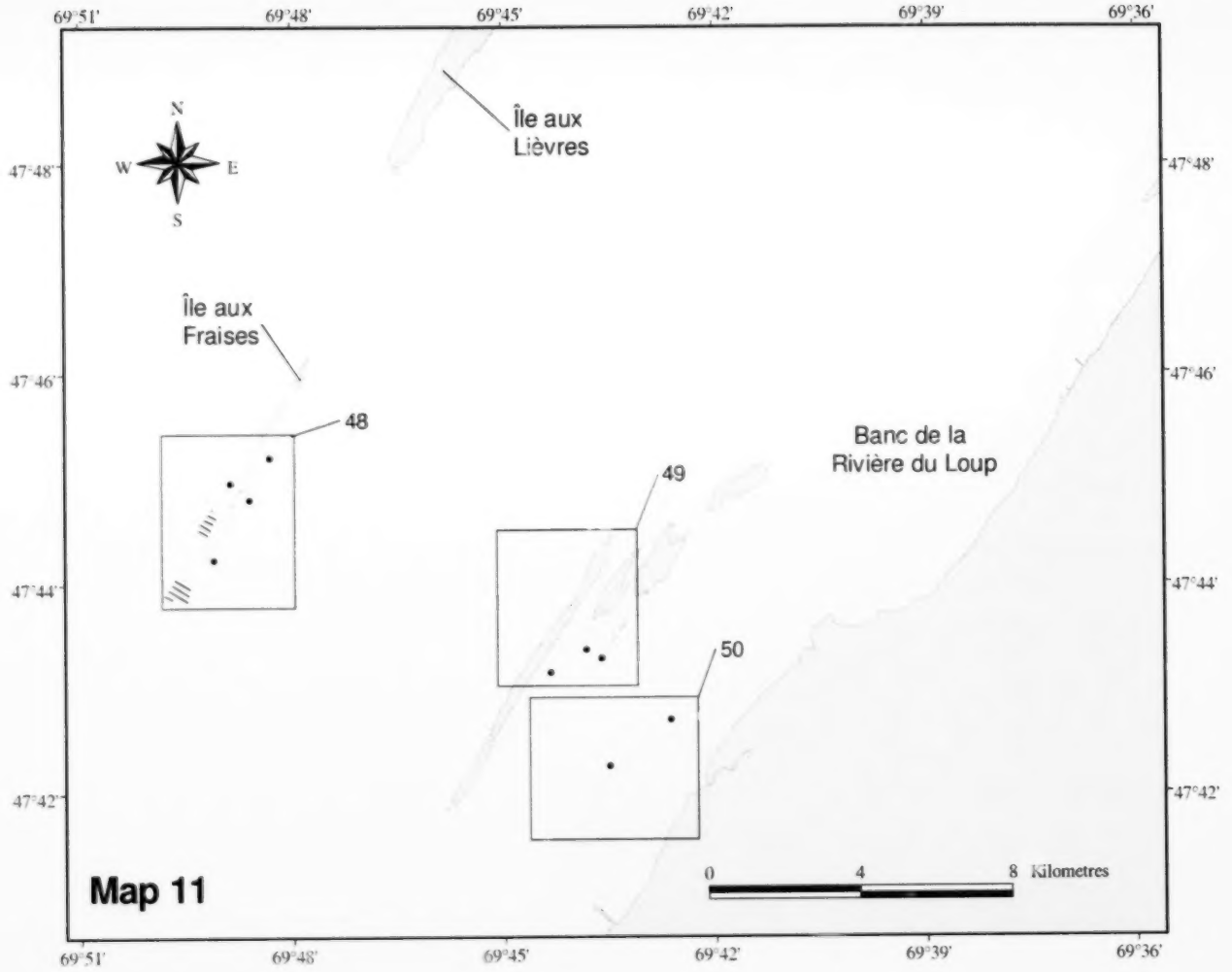
69°42'
69°39'
69°36'
69°33'
69°30'
47°58'
47°56'
47°54'
47°52'
47°50'
N
W
E
S
44
43
Île Blanche
42
45
41
Île aux
Lièvres
47
46
Anse au
Persil
0
4
8 Kilometres

Map 10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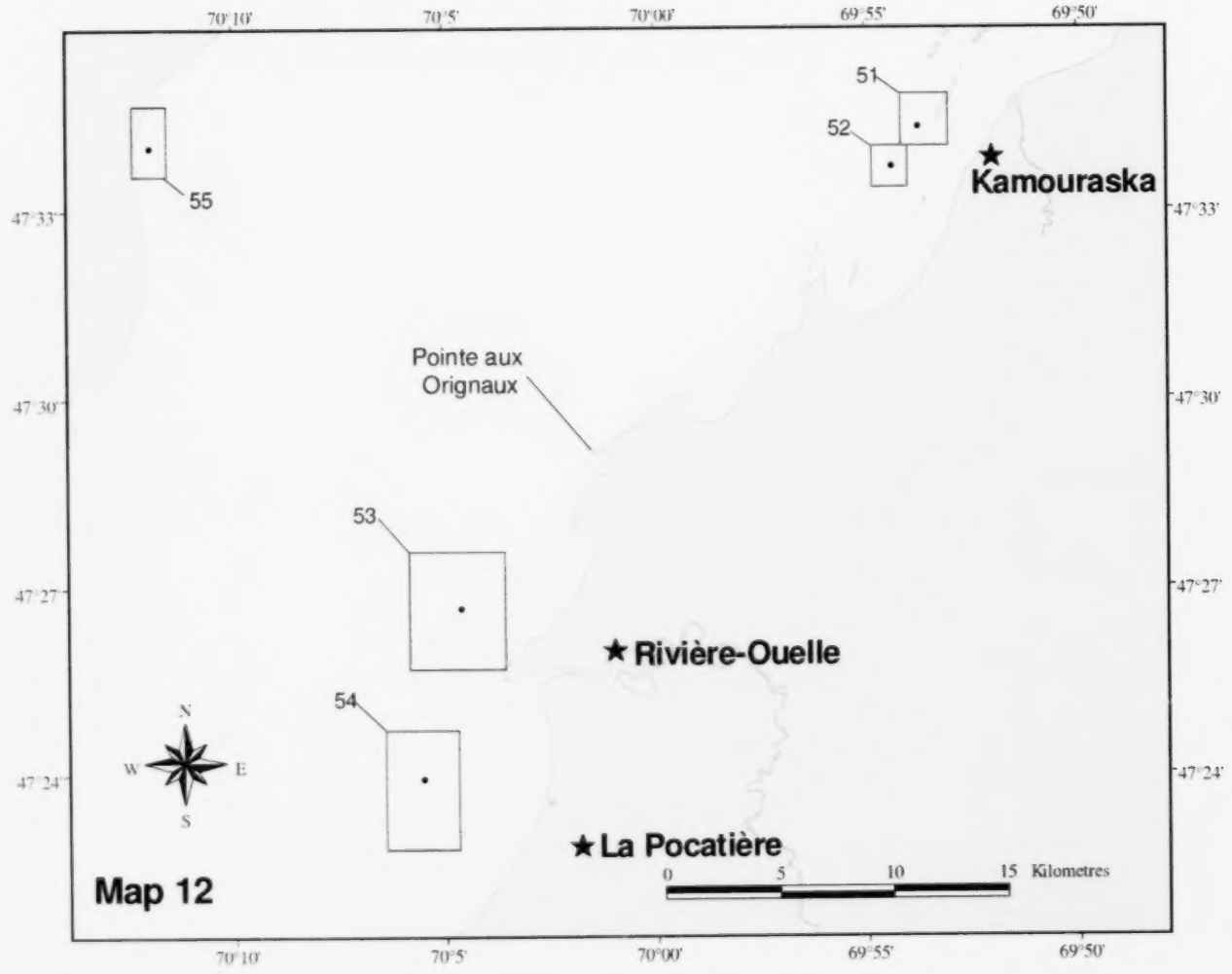
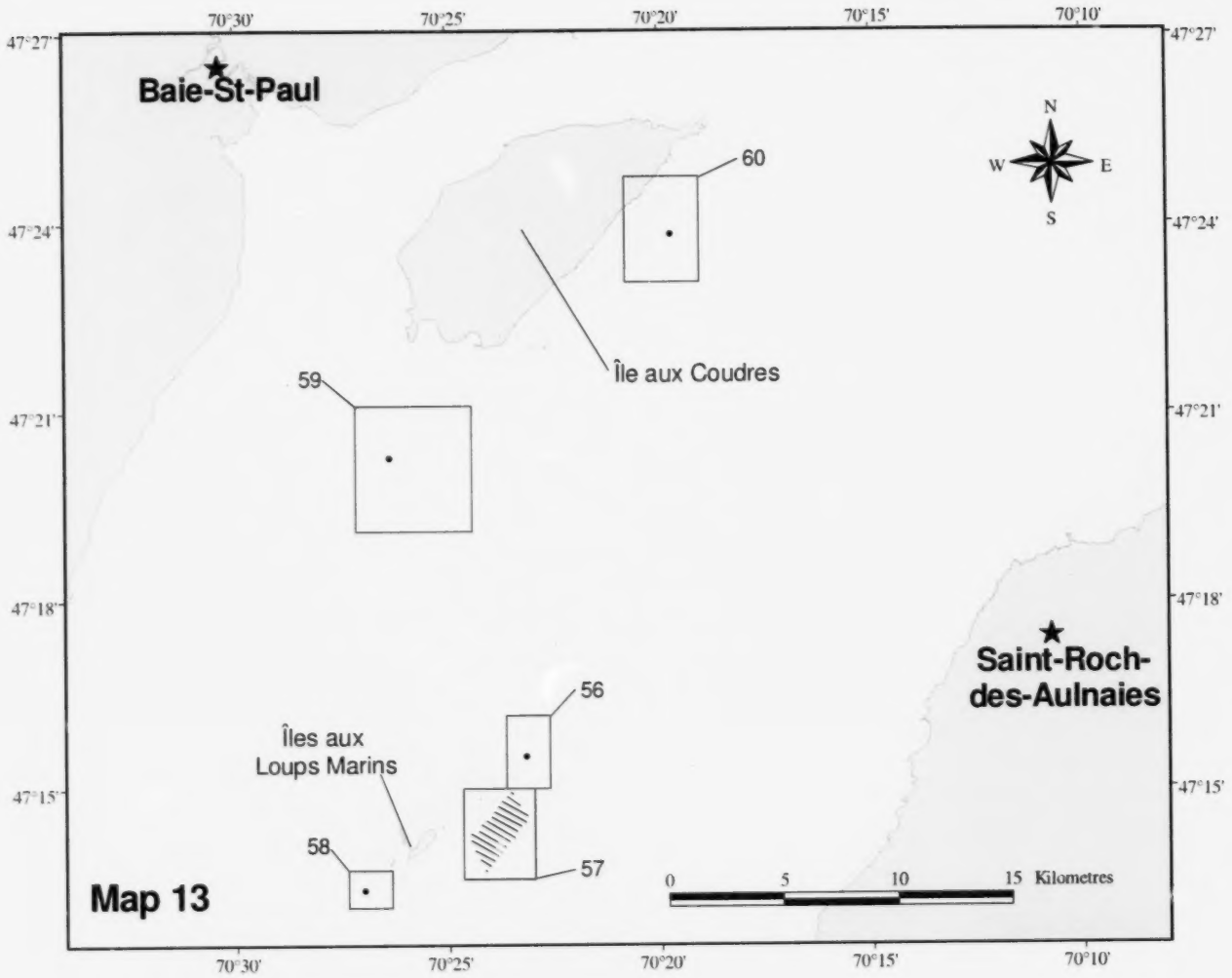
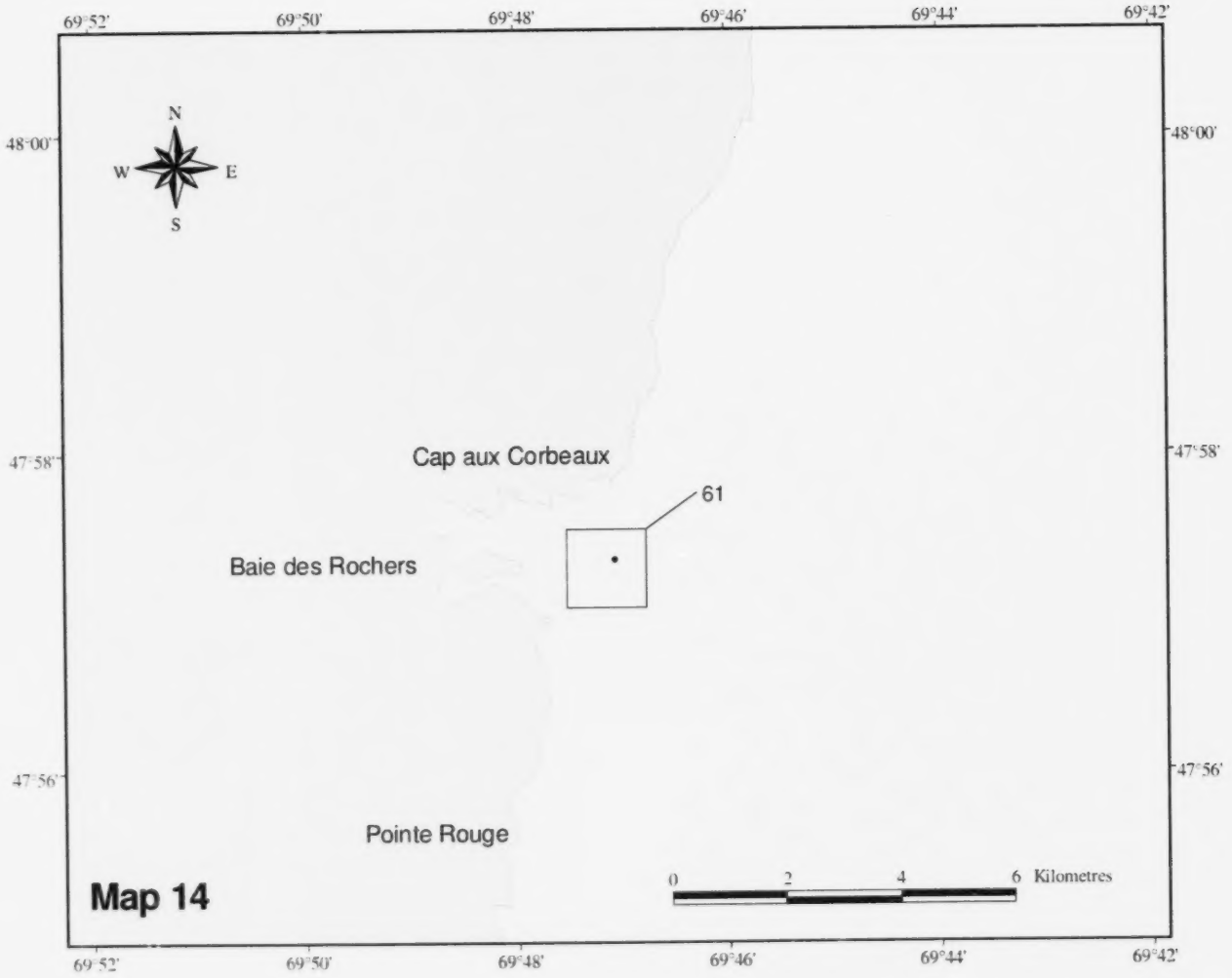
69°48'
69°45'
69°42'
69°39'
69°36'
47°48'
47°46'
47°44'
47°42'
N
W
E
S
Île aux
Lièvres
Île aux
Fraises
48
49
50
Banc de la
Rivière du Loup
0
4
8 Kilometres

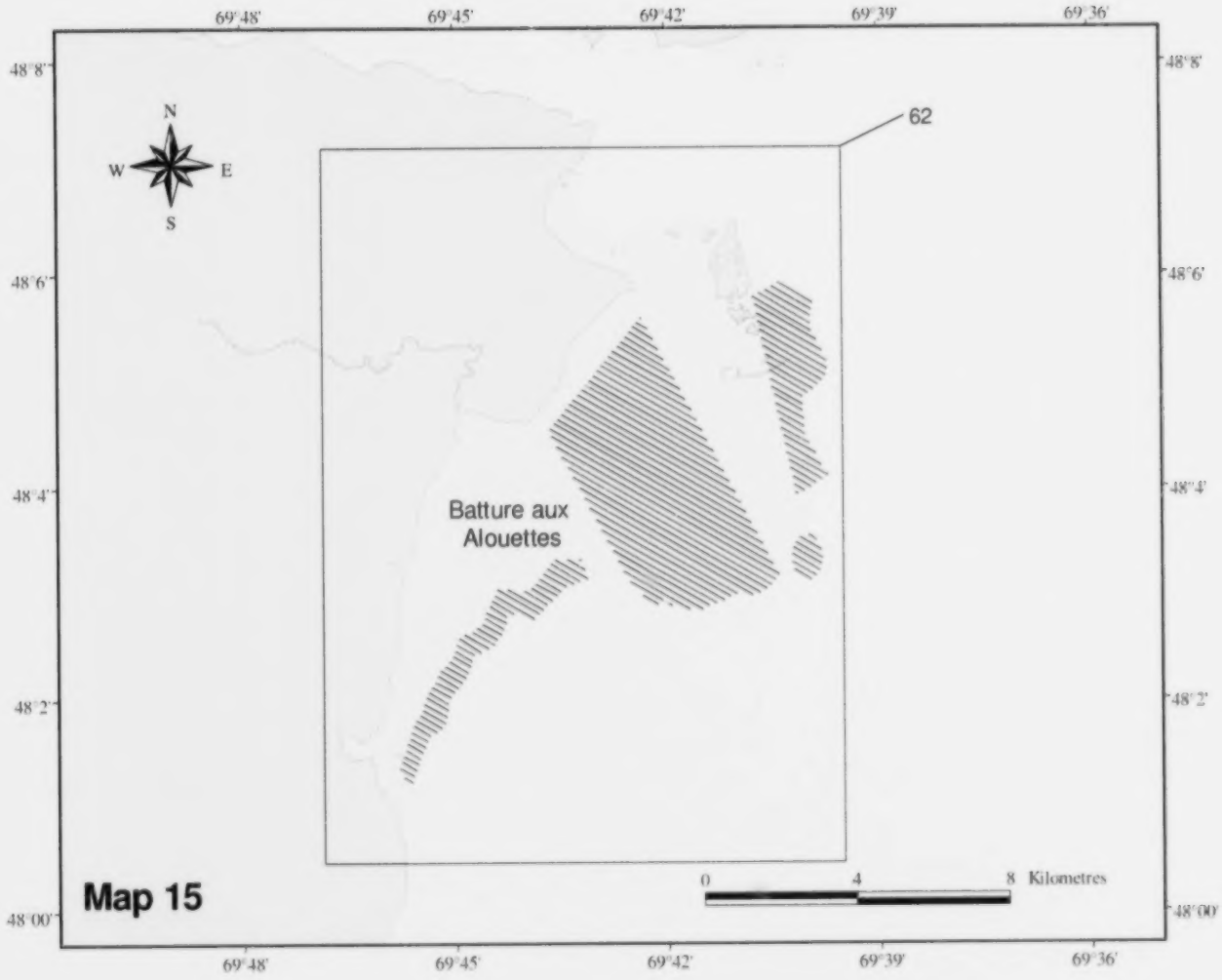
Map 11


70°10'
70°5'
70°00'
69°55'
69°50'
47°33'
47°30'
47°27'
47°24'
51
52
55
Kamouraska
Pointe aux
Orignaux
53
Rivière-Ouelle
54
N
W
E
S
La Pocatière
0
5
10
15 Kilometres
Map 12


70°30'
70°25'
70°20'
70°15'
70°10'
47°27'
47°24'
47°21'
47°18'
47°15'
Baie-St-Paul
N
W
E
S
60
Île aux Coudres
59
Saint-Roch-
des-Aulnaies
56
Îles aux
Loups Marins
58
57
0
5
10
15 Kilometres
Map 13


69°52'
69°50'
69°48'
69°46'
69°44'
69°42'
48°00'
47°58'
47°56'
N
W
E
S
Cap aux Corbeaux
61
Baie des Rochers
Pointe Rouge
0
2
4
6 Kilometres

Map 14


69°48'
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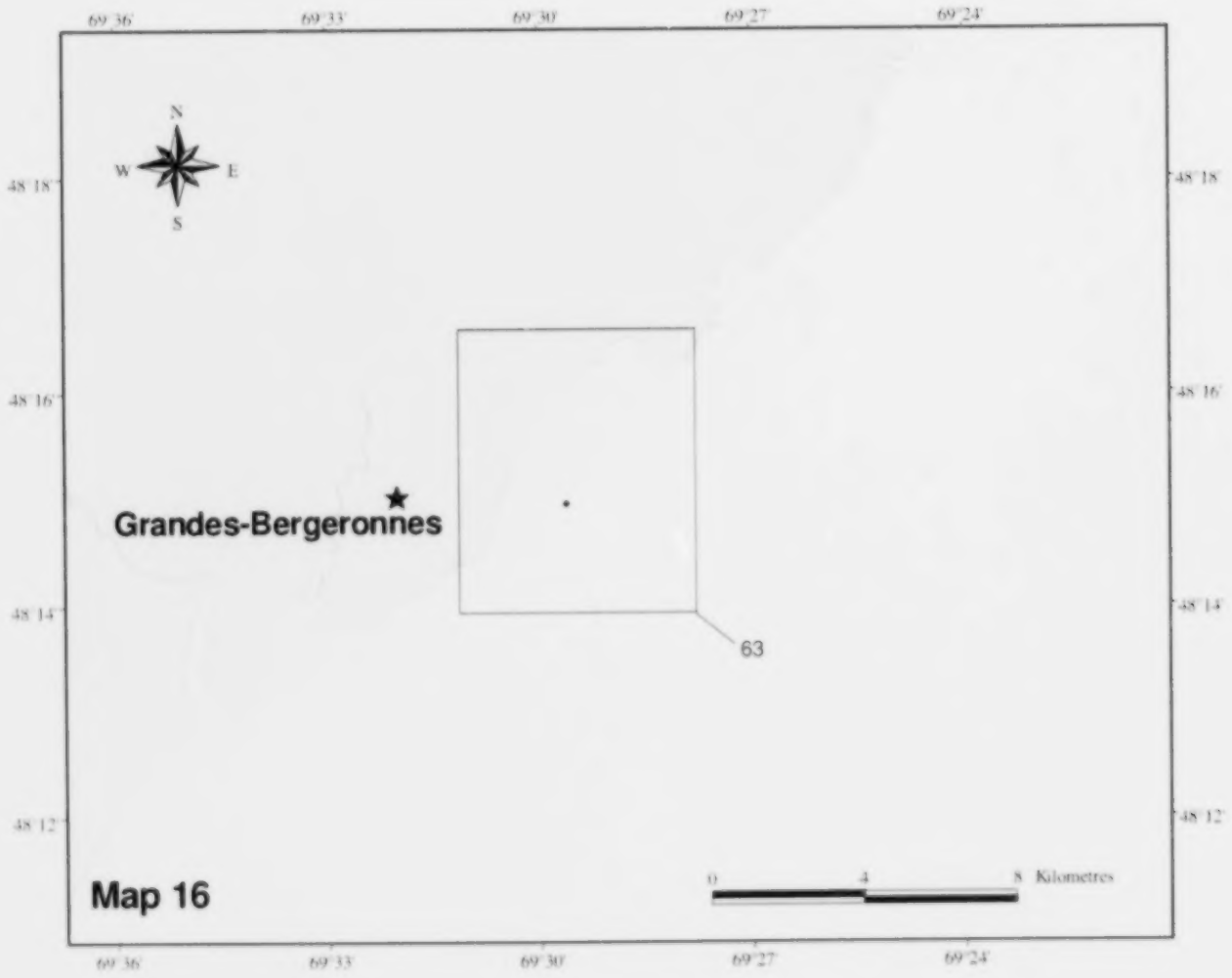
69°42'
69°39'
69°36'
48°8'
48°6'
48°4'
48°2'
48°00'
N
W
E
S
62
Batture aux
Alouettes
0
4
8 Kilometres

Map 15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69°30'
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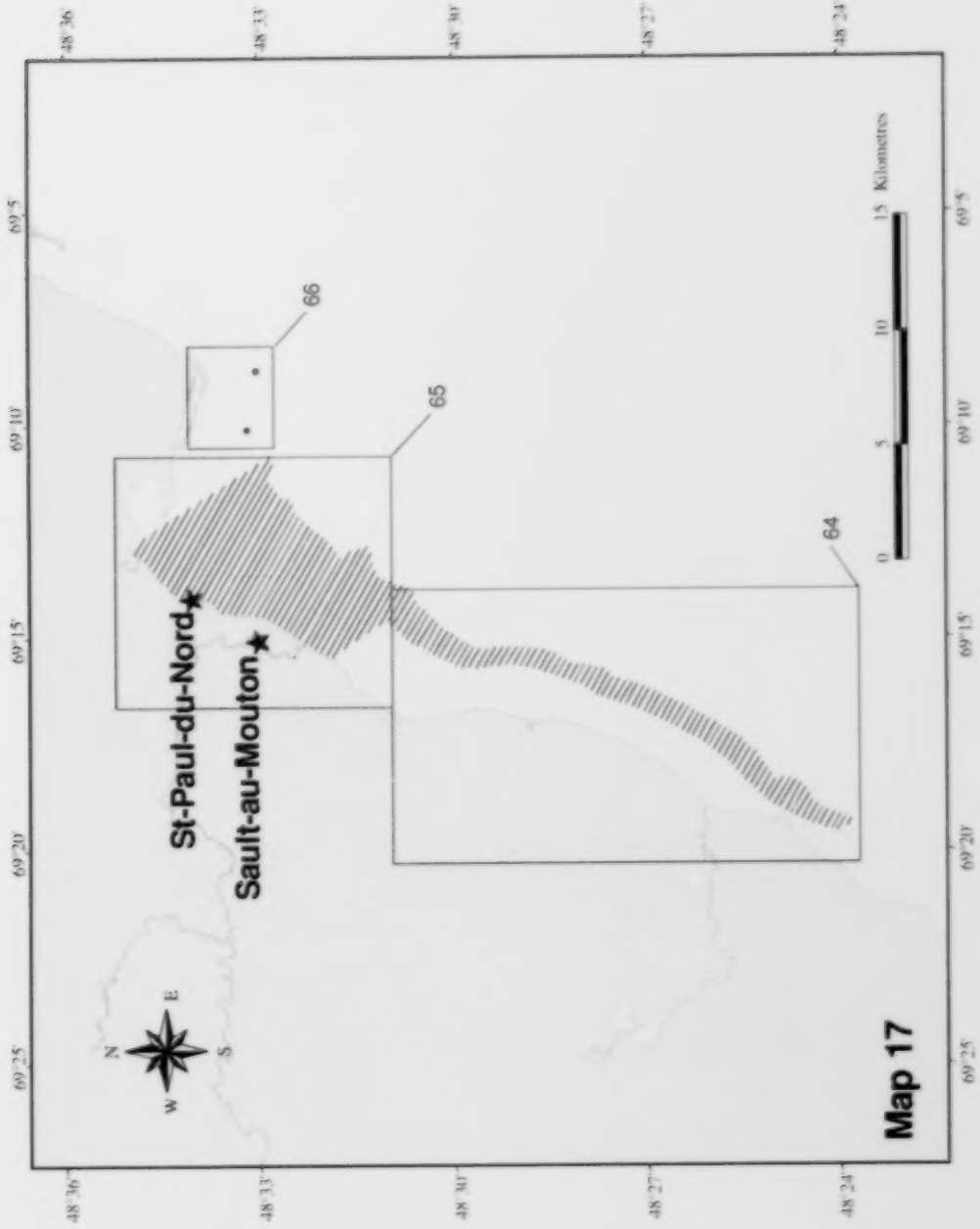
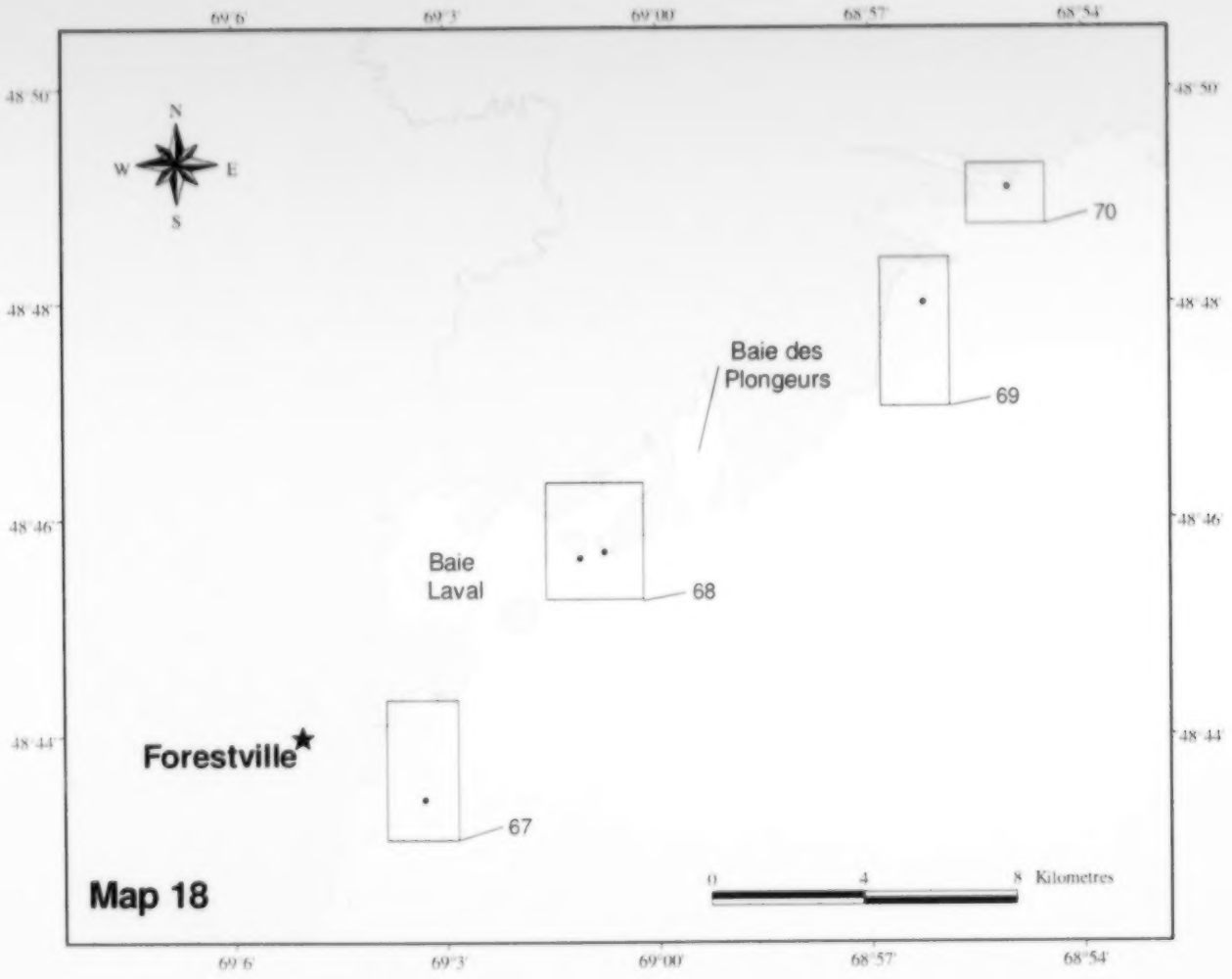
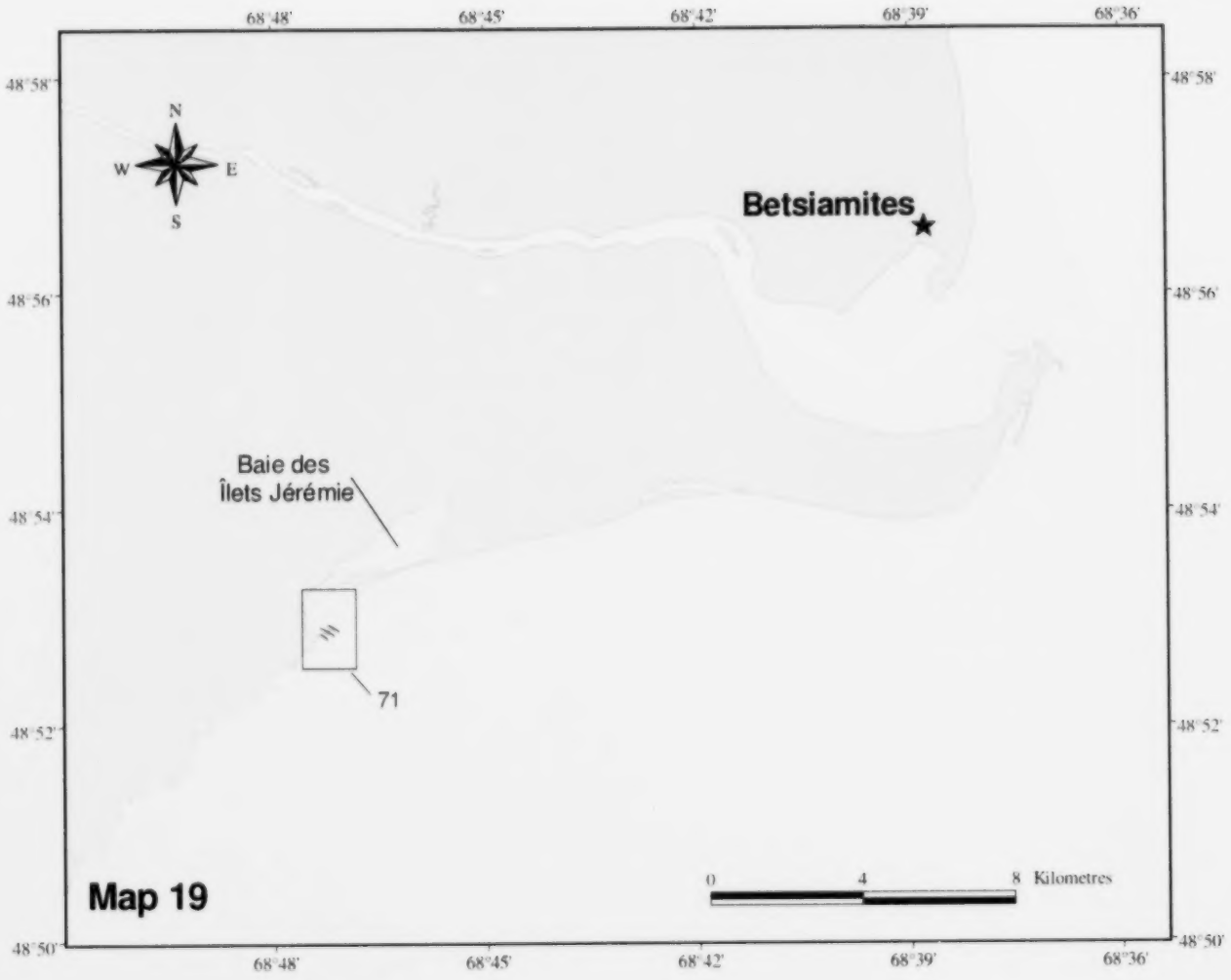
69°24'
N
W
E
S
48°18'
48°16'
48°14'
48°12'
Grandes-Bergeronnes
63
0
4
8 Kilometres

Map 16


48°36'
48°33'
48°30'
48°27'
48°24'
69°25'
69°20'
69°15'
69°10'
69°5'
66
65
64
St-Paul-du-Nord
Sault-au-Mouton
N
E
S
W
0
5
10
15 Kilometres
Map 17


69°6'
69°3'
69°00'
68°57'
68°54'
48°50'
48°48'
48°46'
48°44'
N
W
E
S
70
69
Baie des Plongeurs
Baie Laval
68
Forestville
67
Map 18
0
4
8 Kilometres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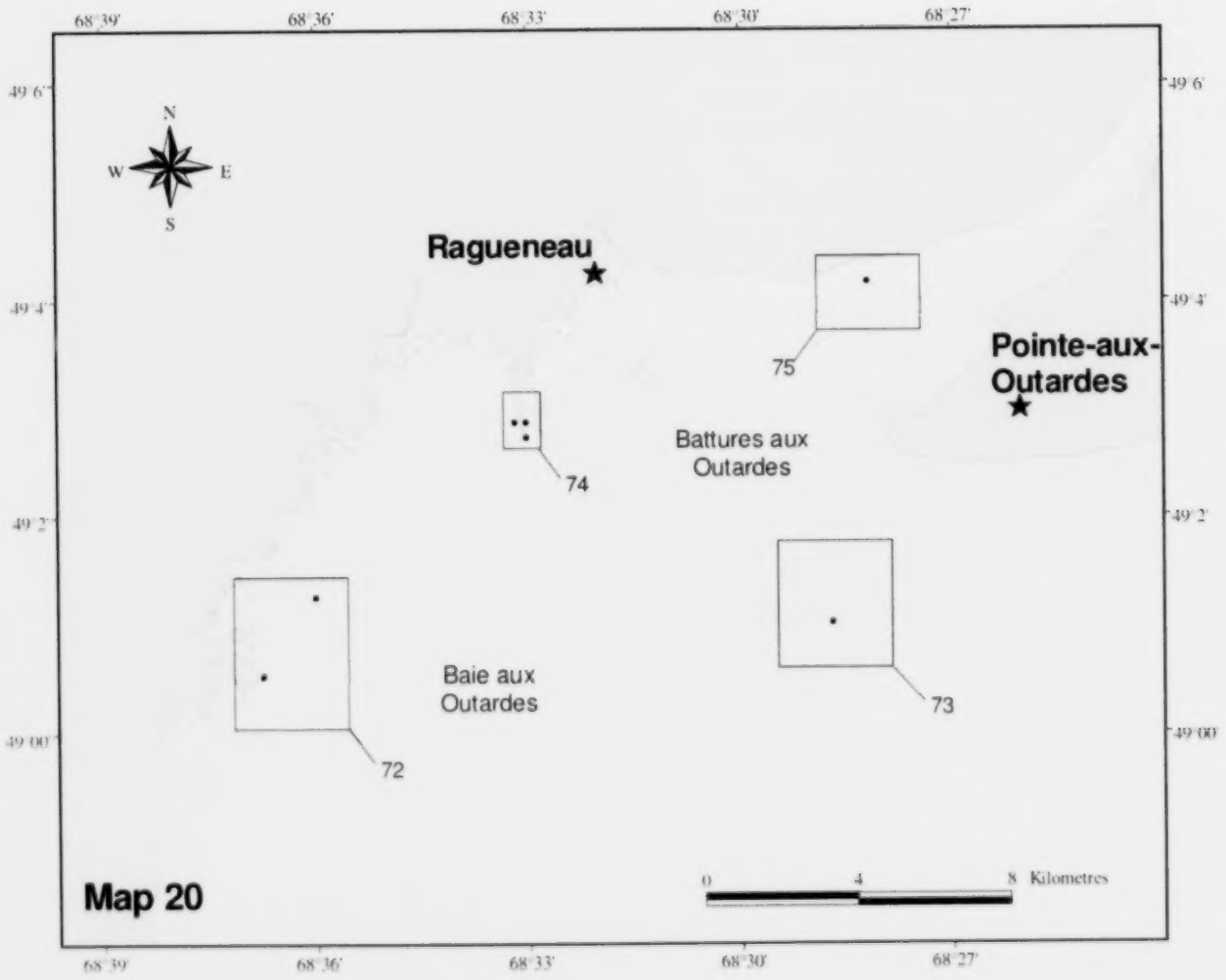
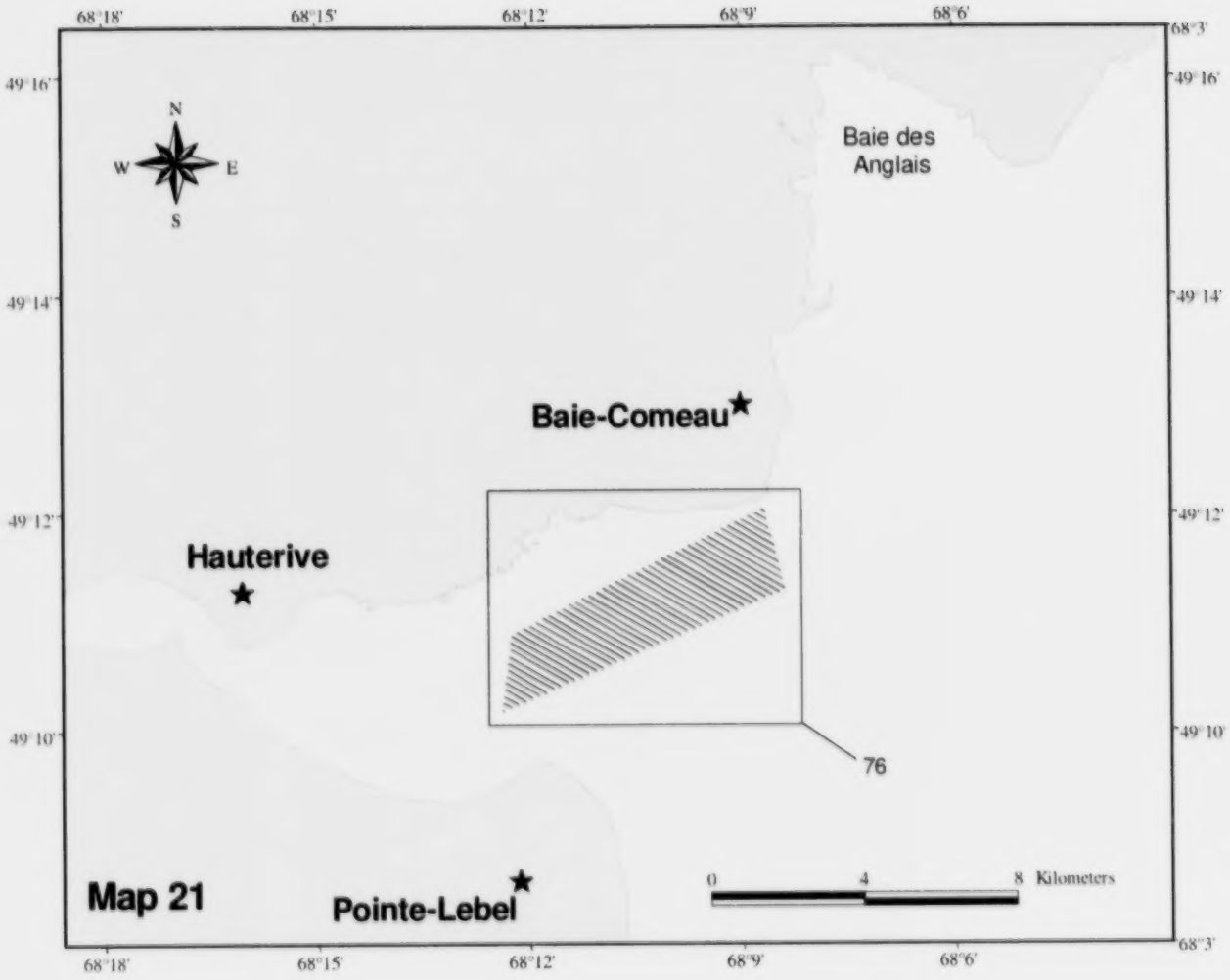
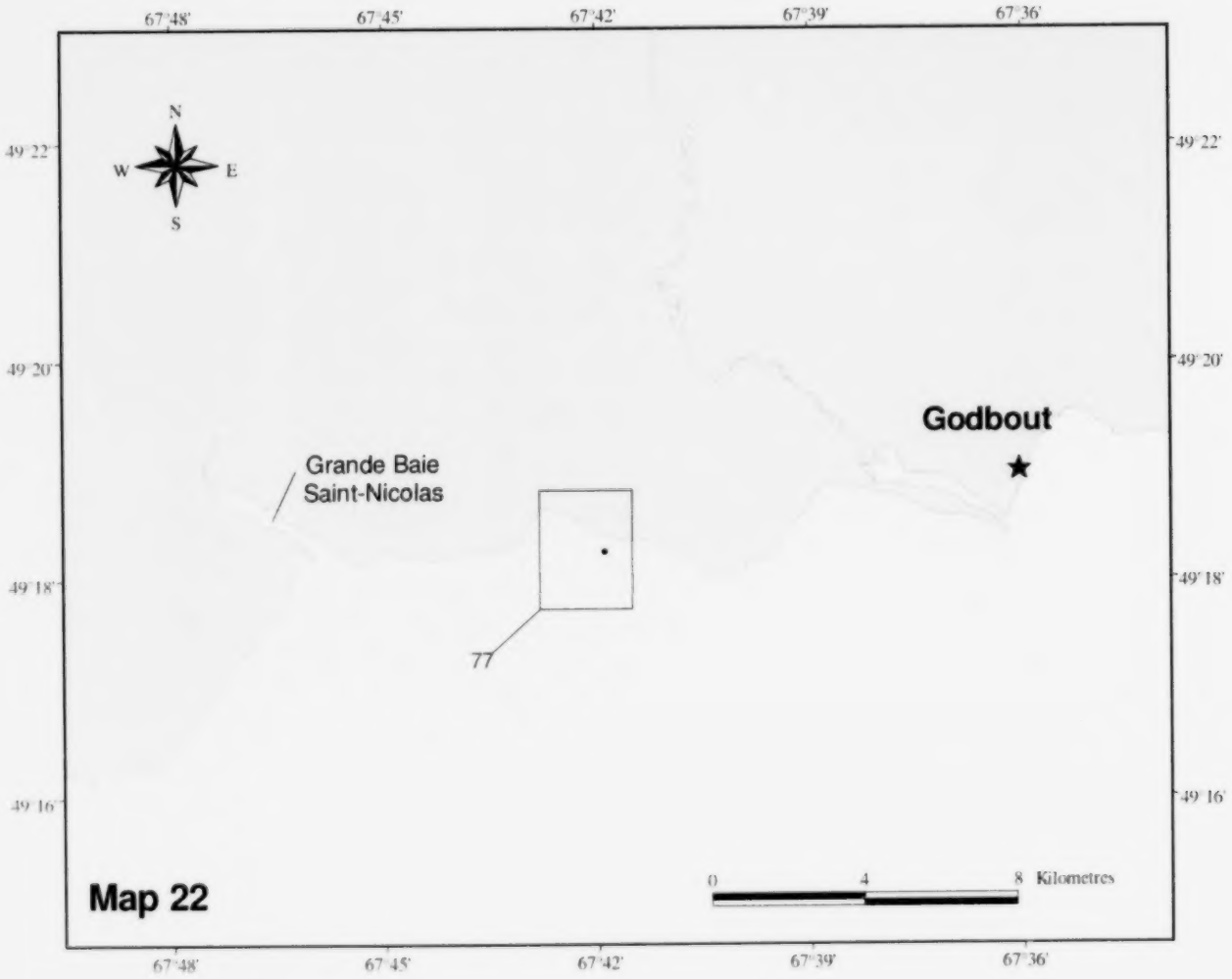
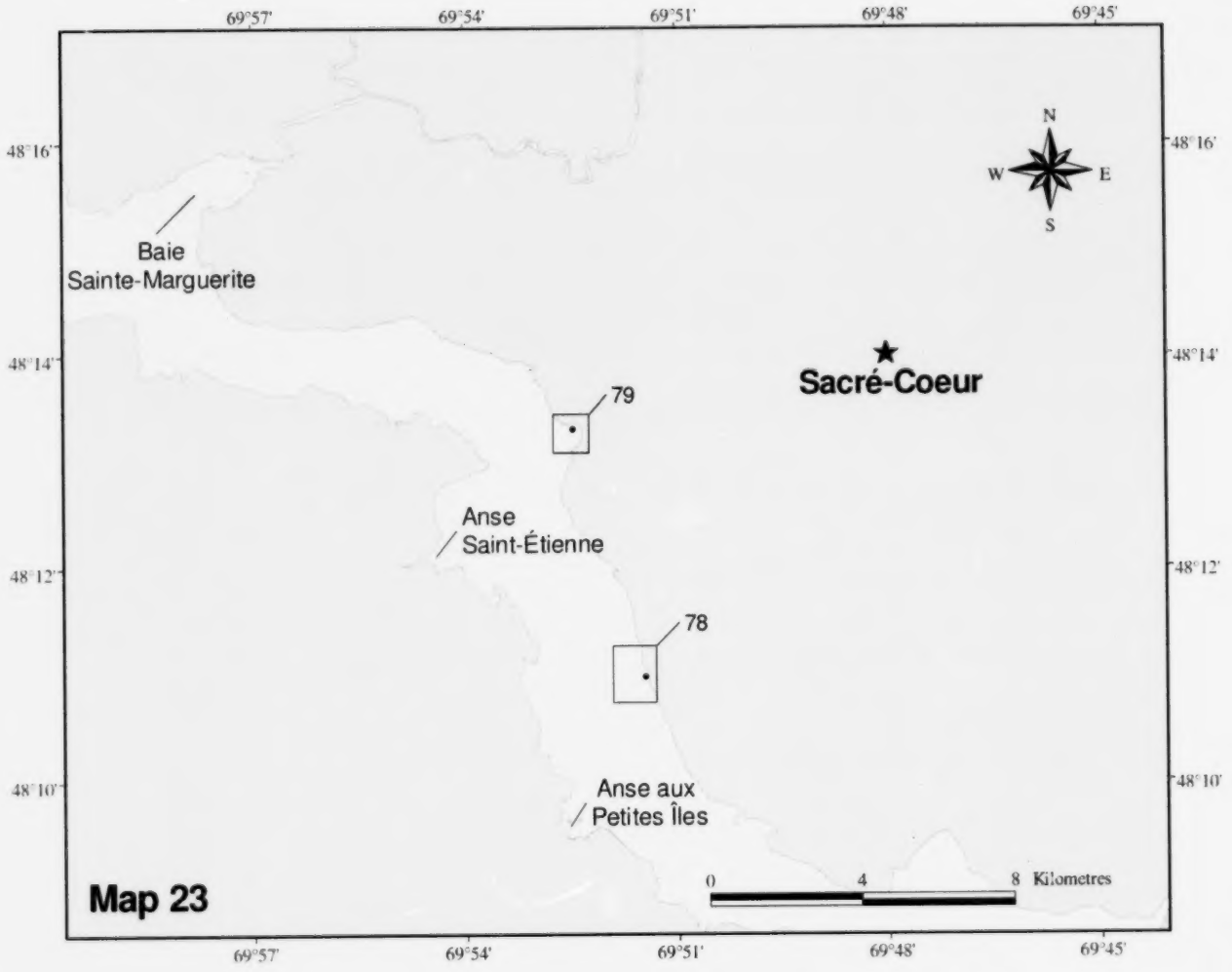
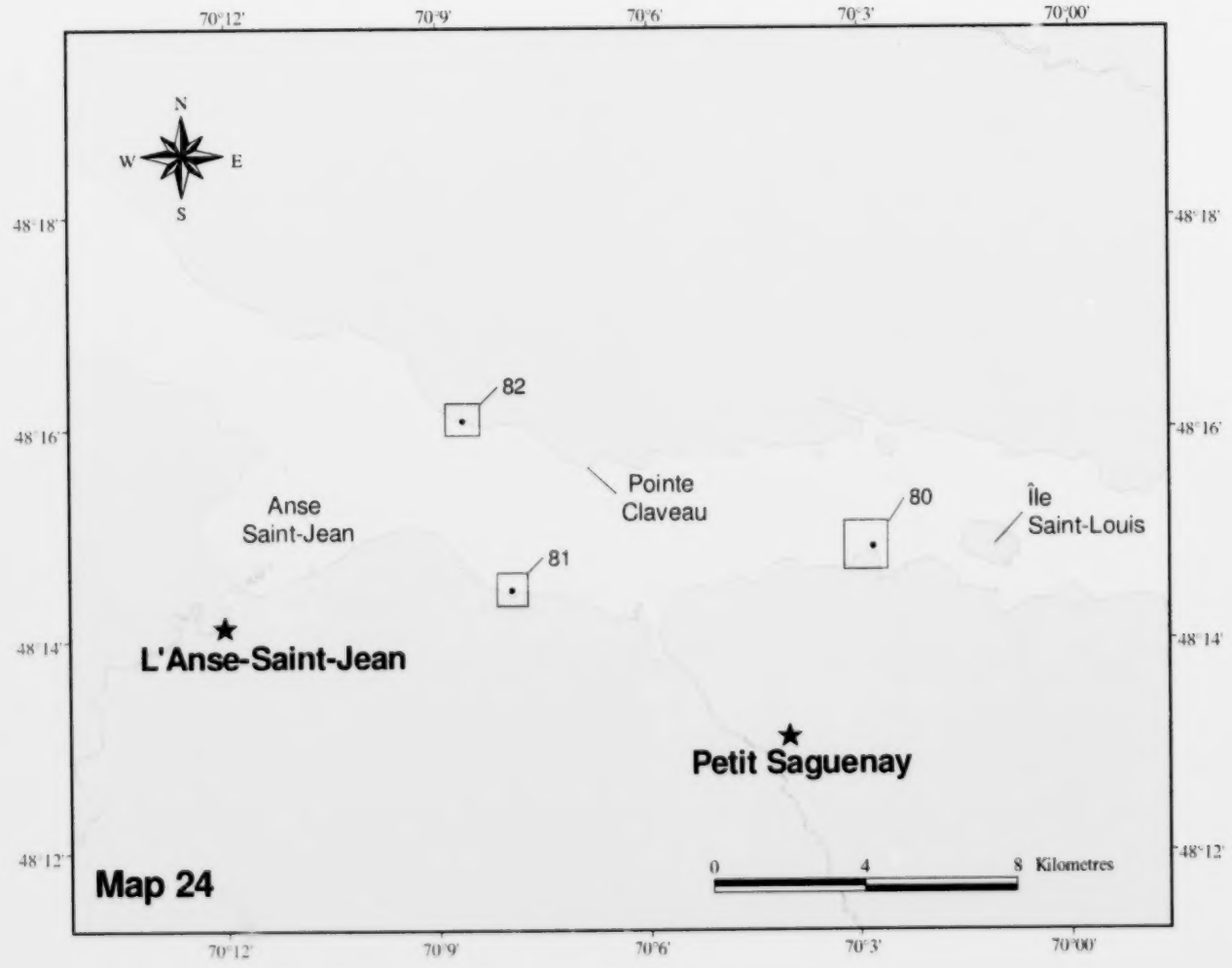
68°45'
68°42'
68°39'
68°36'
48°58'
48°56'
48°54'
48°52'
48°50'
N
W
E
S
Betsiamites
Baie des
Îlets Jérémie
71
Map 19
0
4
8 Kilometres

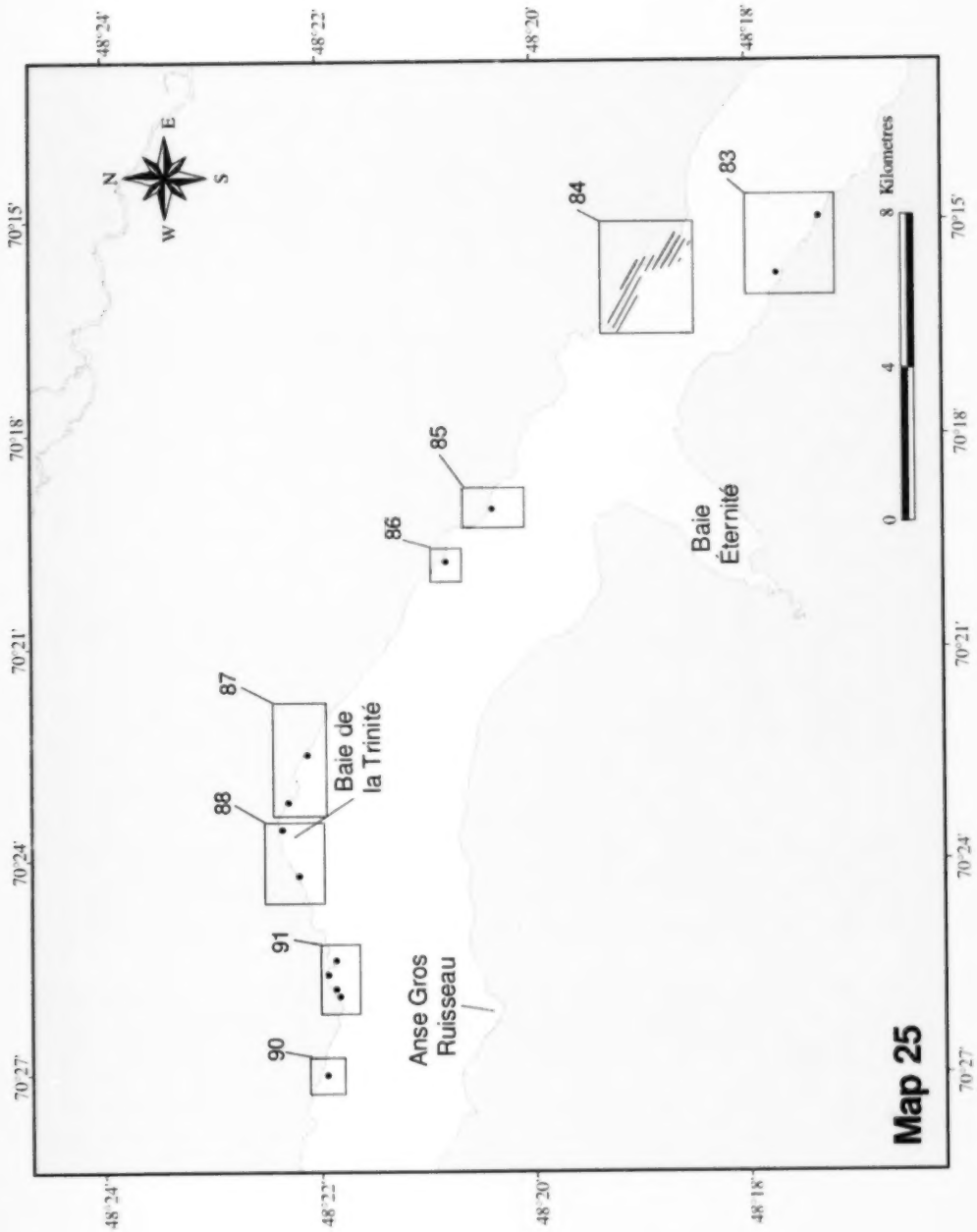

68°39'
68°36'
68°33'
68°30'
68°27'
49°6'
49°4'
49°2'
49°00'
N
W
E
S
Ragueneau
Pointe-aux-Outardes
Battures aux Outardes
Baie aux Outardes
72
73
74
75
0
4
8 Kilometres
Map 20

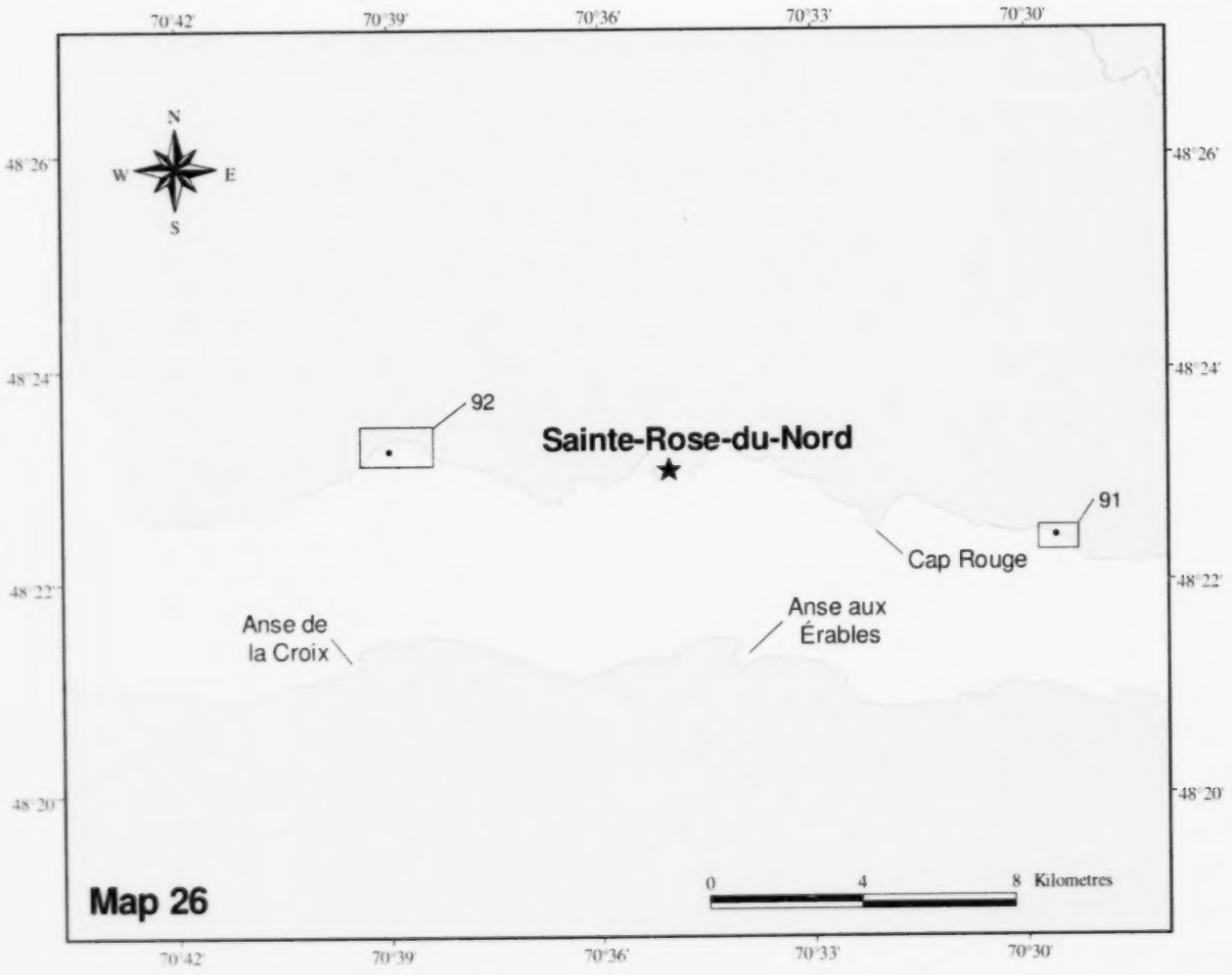

68°18'
68°15'
68°12'
68°9'
68°6'
68°3'
49°16'
49°14'
49°12'
49°10'
N
W
E
S
Baie des
Anglais
Baie-Comeau
Hauterive
Pointe-Lebel
76
Map 21
0
4
8 Kilometers

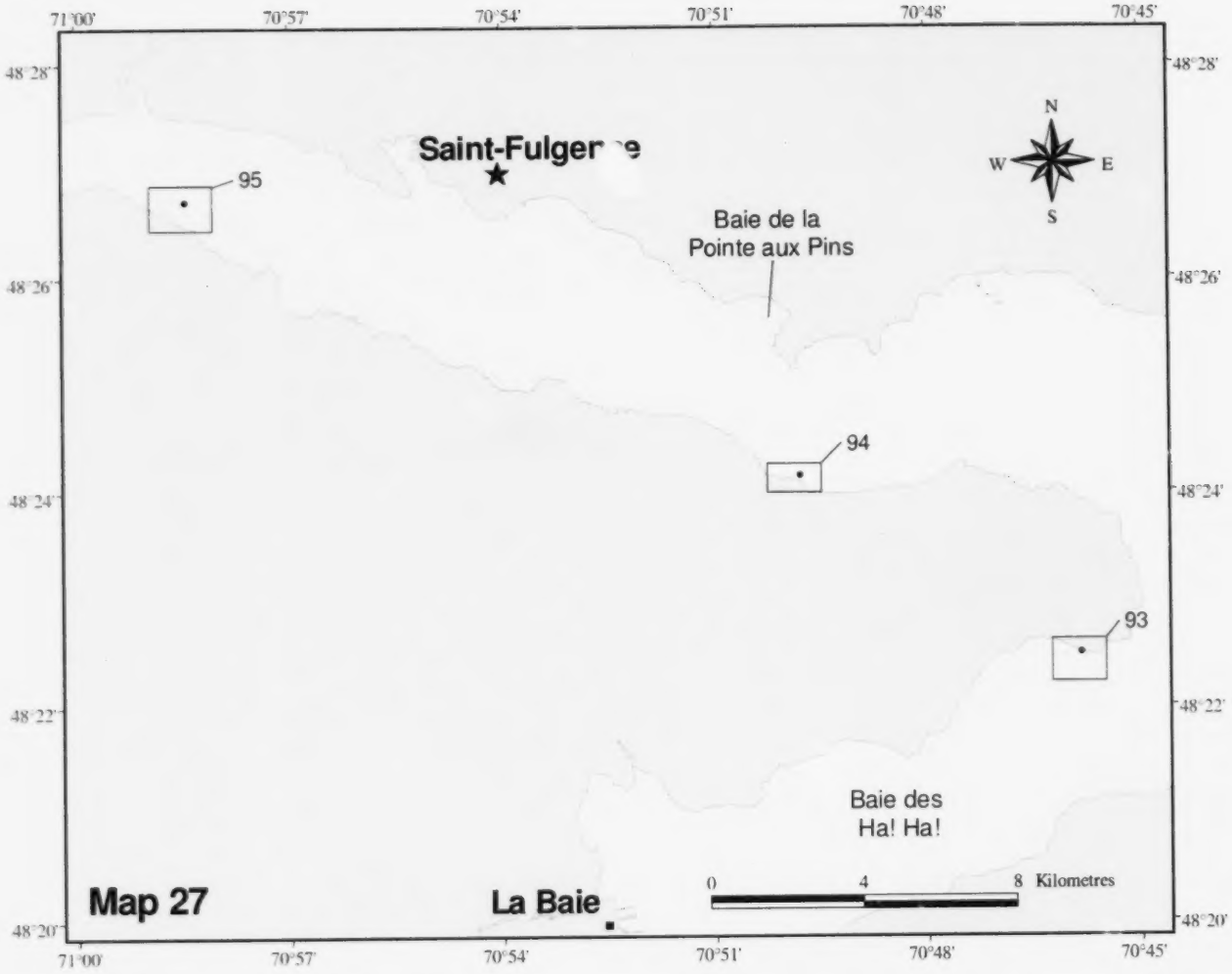

67°48'
67°45'
67°42'
67°39'
67°36'
49°22'
49°20'
49°18'
49°16'
N
W
E
S
Godbout
Grande Baie
Saint-Nicolas
77
Map 22
0
4
8 Kilometres


69°57'
69°54'
69°51'
69°48'
69°45'
48°16'
48°14'
48°12'
48°10'
N
W
E
S
Baie
Sainte-Marguerite
Sacré-Coeur
79
Anse
Saint-Étienne
78
Anse aux
Petites Îles
0
4
8 Kilometres
Map 23


70°12'
70°9'
70°6'
70°3'
70°00'
N
W
E
S
48°18'
48°16'
48°14'
48°12'
82
Pointe
Claveau
80
Île
Saint-Louis
Anse
Saint-Jean
81
L'Anse-Saint-Jean
Petit Saguenay
Map 24
0
4
8 Kilometres


48°24'
48°22'
48°20'
48°18'
70°27'
70°24'
70°21'
70°18'
70°15'
N
S
E
W
0
4
8 Kilometres
83
84
85
86
87
88
90
91
Baie de la Trinité
Anse Gros Ruisseau
Baie Éternité
Map 25


70°42'
70°39'
70°36'
70°33'
70°30'
N
W
E
S
48°26'
48°24'
48°22'
48°20'
92
Sainte-Rose-du-Nord
91
Cap Rouge
Anse de
la Croix
Anse aux
Érables
0
4
8 Kilometres
Map 26


71°00'
70°57'
70°54'
70°51'
70°48'
70°45'
48°28'
48°26'
48°24'
48°22'
48°20'
Saint-Fulgence
95
94
93
Baie de la
Pointe aux Pins
Baie des
Ha! Ha!
N
W
E
S
0
4
8 Kilometres
Map 27
La Baie

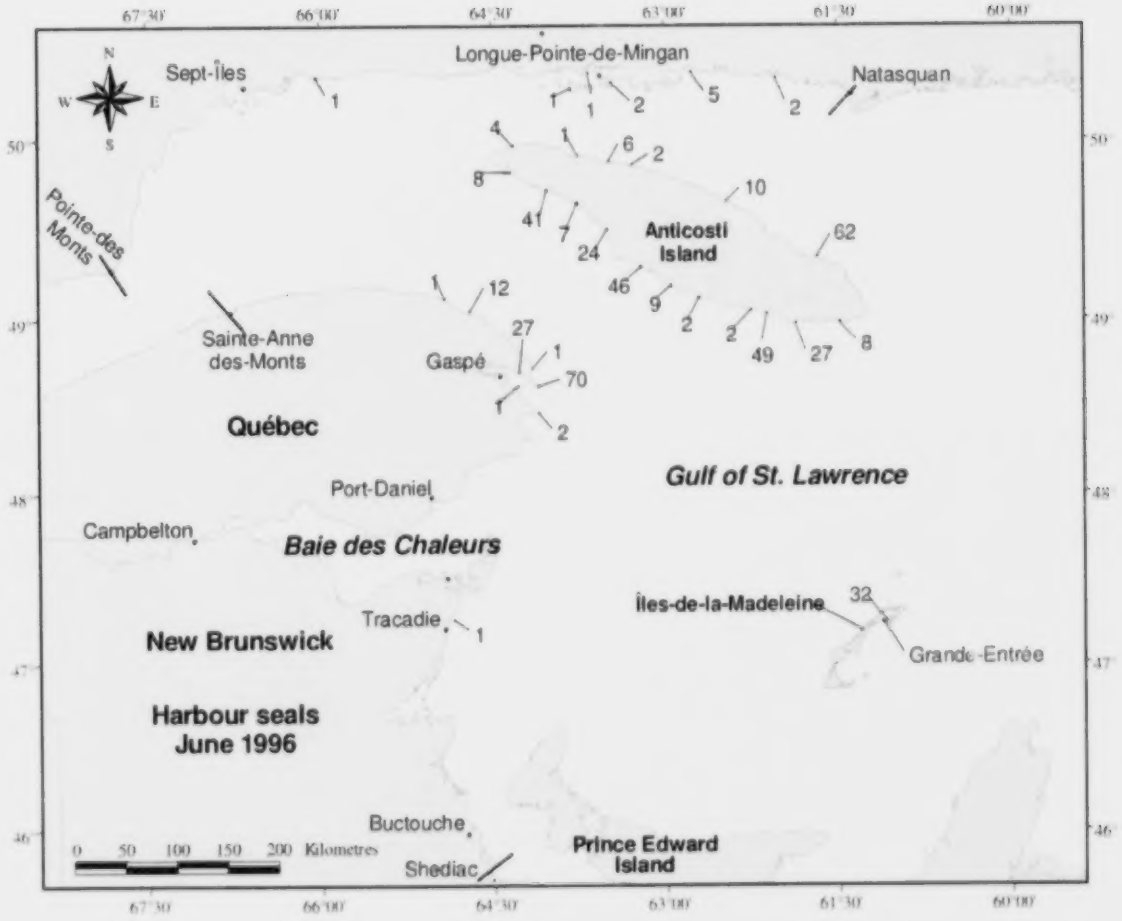
APPENDIX II.2

Harbour seals in the Gulf of St. Lawrence in 1996 and 2001

APPENDIX II.2.1

Harbour seal sightings in the Gulf of St. Lawrence in 1996 and 2001

Distribution and abundance


67°30
66°00
64°30
63°00
61°30
60°00
50
49
48
47
46
N
W
E
S
Sept-Îles
Longue-Pointe-de-Mingan
Natasquan
Pointe-des Monts
Anticosti Island
Sainte-Anne des-Monts
Gaspé
Québec
Gulf of St. Lawrence
Port-Daniel
Campbelton
Baie des Chaleurs
Îles-de-la-Madeleine
Tracadie
New Brunswick
Grande-Entrée
Harbour seals
June 1996
Buctouche
Prince Edward Island
Shediac
0 50 100 150 200 Kilometres

Gulf of St. Lawrence
North Cap
East Point
Covehead Bay
Cape Egmont
Prince Edward Island
Charlottetown
Shediac
Buctouche
Nova Scotia
Harbour seals
June 2001
19
110
83
109
5
4
82
11
0 50 100 150 200 Kilometres

APPENDIX II.2.2

Harbour seal sightings in the Gulf of St. Lawrence

Number of individuals observed at each haul-out site during each survey with associated haul-out substrate. Zone IDs in the table refer to material presented in Figure 5.

Appendix II.2.2

Zone ID	Area (name or position : lat.°N, long.°W)	June 1996	June 2001	Substrate
1	64°53.5 49°11.63 (east of Cloridorme)	1	-	ir
1	49°08 64°43	1	-	ir
1	49°06.88 64°38.20	11	-	ir
2	48°49.75 64°13.09	1	-	r
2	rocks just off the cliff 48°48.96 64°16.75	26	-	cl
2	between 48°45 64°08 and 48°47 64°12.5	70	-	cl
2	east of Petit Cap-aux-Os	1	-	ir
3	48°44.048 64°18.95	1	-	ir
3	SE point of Île Plate		-	i
4	47°17 64°57.8	1	-	sb
9	47°33.53 61°35.14 N of point of Grande Entrée	32	-	undetermined
10	Cap Henri	1	-	w
10	Bay of Cap Henri	1	-	ir
10	Baie Ellis	6	-	ir
11	49°42.95 64°06.04	41	-	r conn land
12	49°40.00 63°55.19	1	-	ir
12	49°39 63.54	1	-	ir
12	49°38 63°49	5	-	ir
12	49°32.09 63°40.28	5	-	ir
12	49°32.08 63°39.54	18	-	ir
12	49°29.53 63°37.40	1	-	ir
13	49°21.66 63°27.40	45	-	ir, r conn land
13	49°19.03 63°19.35	1	-	ir
13	between 49°19 63°19 and 49°14 63°07	8	-	r
13	49°14.25 63°07.47	1	-	ir
13	49°11.91 62°57.66	2	-	ir
14	49°07.64 62°33.35	2	-	ir
14	49°06.73 62°28.00	39	-	sb, ir
14	49°06 62°27	9	-	ir
14	49°05.77 62°23.34	1	-	ir
14	49°03.88 62°15.27	25	-	ir
14	49°03.7 62°12	2	-	ir
15	49°04 61°54	8	-	sb
16	49°23.10 62°01.68	4	-	ir
16	49°23 62°02	41	-	ir, cl
16	49°23 62°04	17	-	undetermined
17	49°39.8 62°44.45	10	-	undetermined
18	49°50.37 63°27.10	2	-	ir
18	49°51.30 63°37.60	6	-	ir
18	49°53.25 63°52.8	1	-	ir
19	49°55.99 64°22.24	4	-	ir

ir = isolated rocks; i = islands; r = reefs; sb = sand banks; cl = rocks or beach at the bottom of a cliff; b = beaches; r conn land = reef connected to land; w = seals in the water

Appendix II.2.2. (Continued)

Zone ID	Area (name or position : lat.°N, long.°W)	June 1996	June 2001	Substrate
20	50°15.50 62°21.88	2	-	r
21	E of entrance to Baie de la Grande Hermine	2	-	r
21	W of entrance to Baie de la Grande Hermine	3	-	r
21	W of Pointe aux Esquimaux 58°14 63°38	1	-	ir
21	SW of Ile Moniac	1	-	ir
21	Ile du Havre de Mingan - S side	1	-	ir
21	SW point of Grande Ile	1	-	ir
22	E point of Baie de Moisie 50°14.76 65°50.2	1	-	ir
5	East point of St. Peters Island	-	3	ir
5	SE point of St. Peters Island	-	1	ir
5	SW of Governors Island	-	7	ir
5	NW point of Governors Island	-	75	ir
5	Squaw Point	-	9	ir
5	Pownal Bay	-	100	w
5	Point Prim	-	11	ir
6	before Wood Island, just off Indian rocks	-	5	sb
7	Cape Bear, on sand bank	-	9	sb
7	Cape Bear, 2nd island to the W	-	15	ir
7	Cape Bear, 46°02 62°30	-	59	ir
7	Entrance to Murray Harbour, 46°02 62°28	-	110	sb
8	Rollo Bay, S end of sand bank	-	19	sb

ir = isolated rocks; i = island; r = reefs; sb = sand banks; cl = rocks or beach at the bottom of a cliff; b = beaches; r conn land = reef connected to land; w = seals in the water

APPENDIX III

Grey seals

Sightings in the Estuary and Gulf of St. Lawrence during aerial surveys flown in 1994–1997, 2000 and 2001

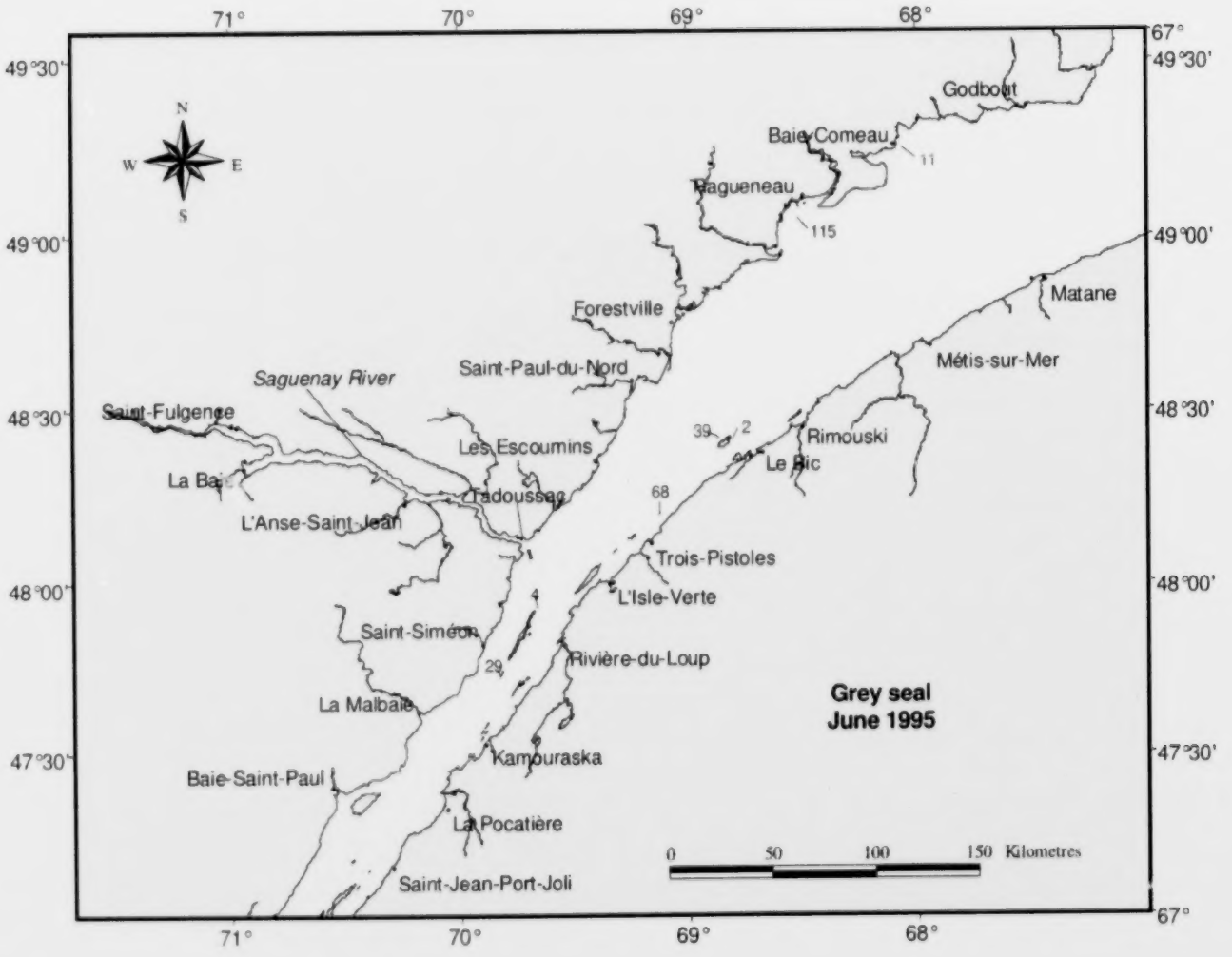
APPENDIX III.1

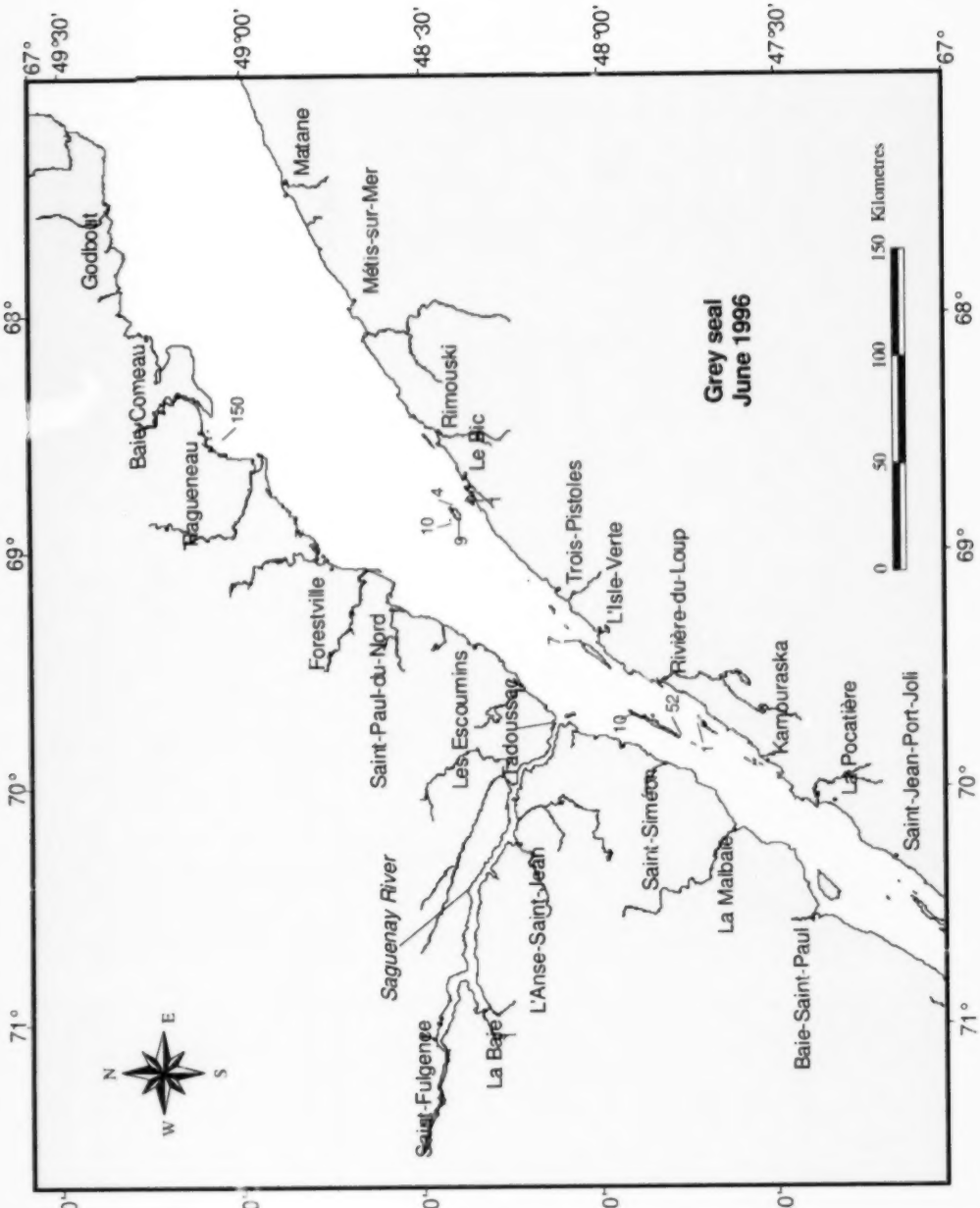
Grey seals in the St. Lawrence Estuary and Saguenay River, 1994–2000

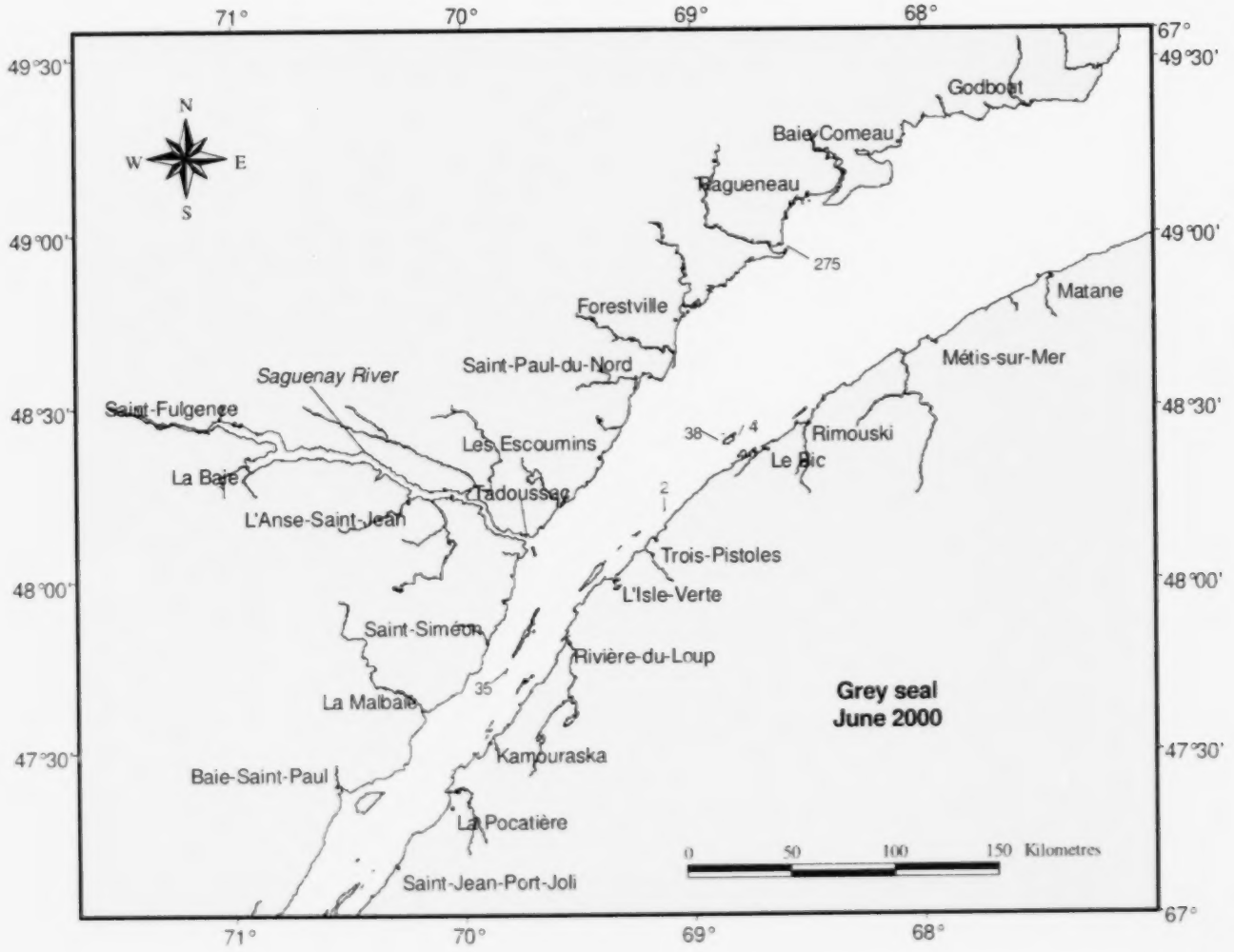
APPENDIX III.1.1

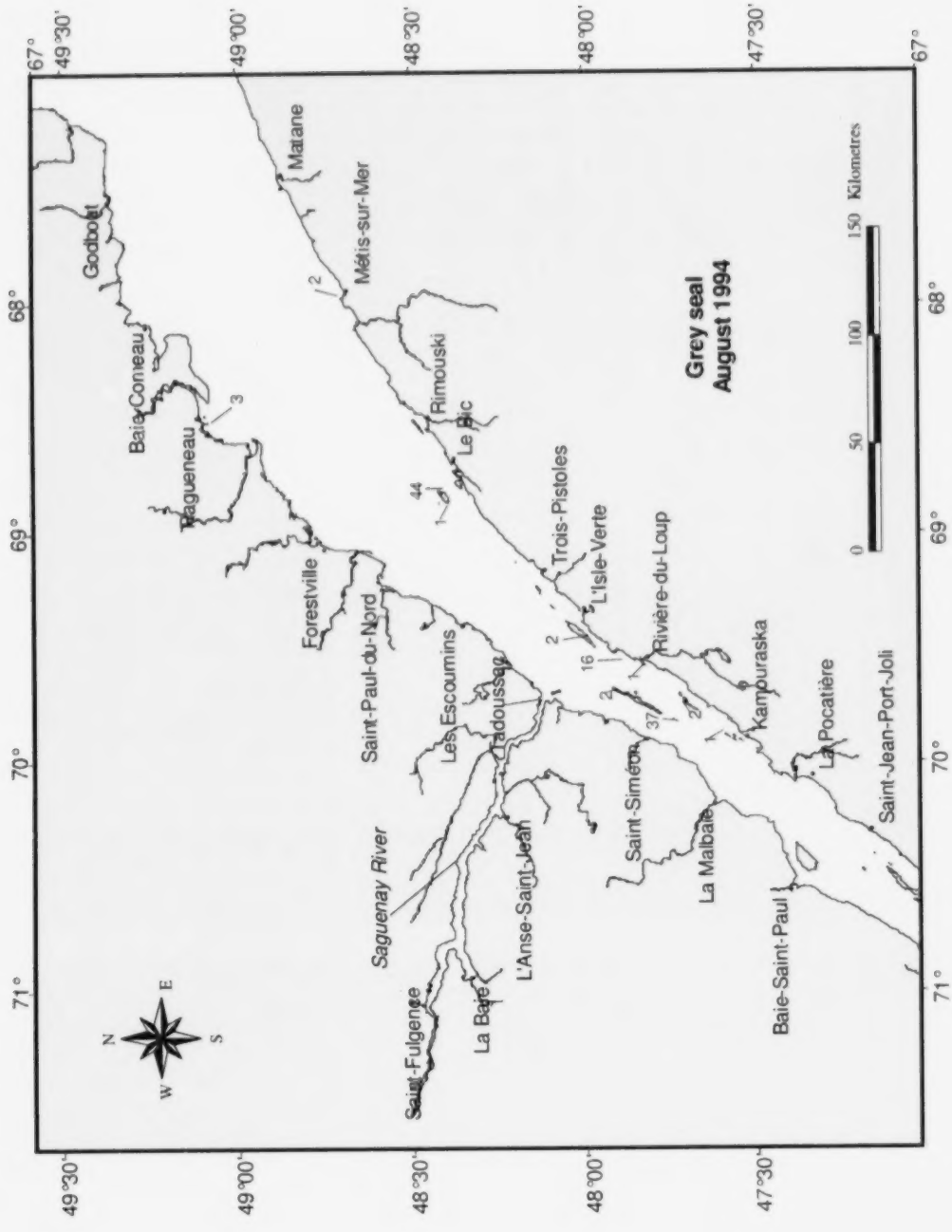
Grey seal sightings in the St. Lawrence Estuary and Saguenay River, 1994–2000

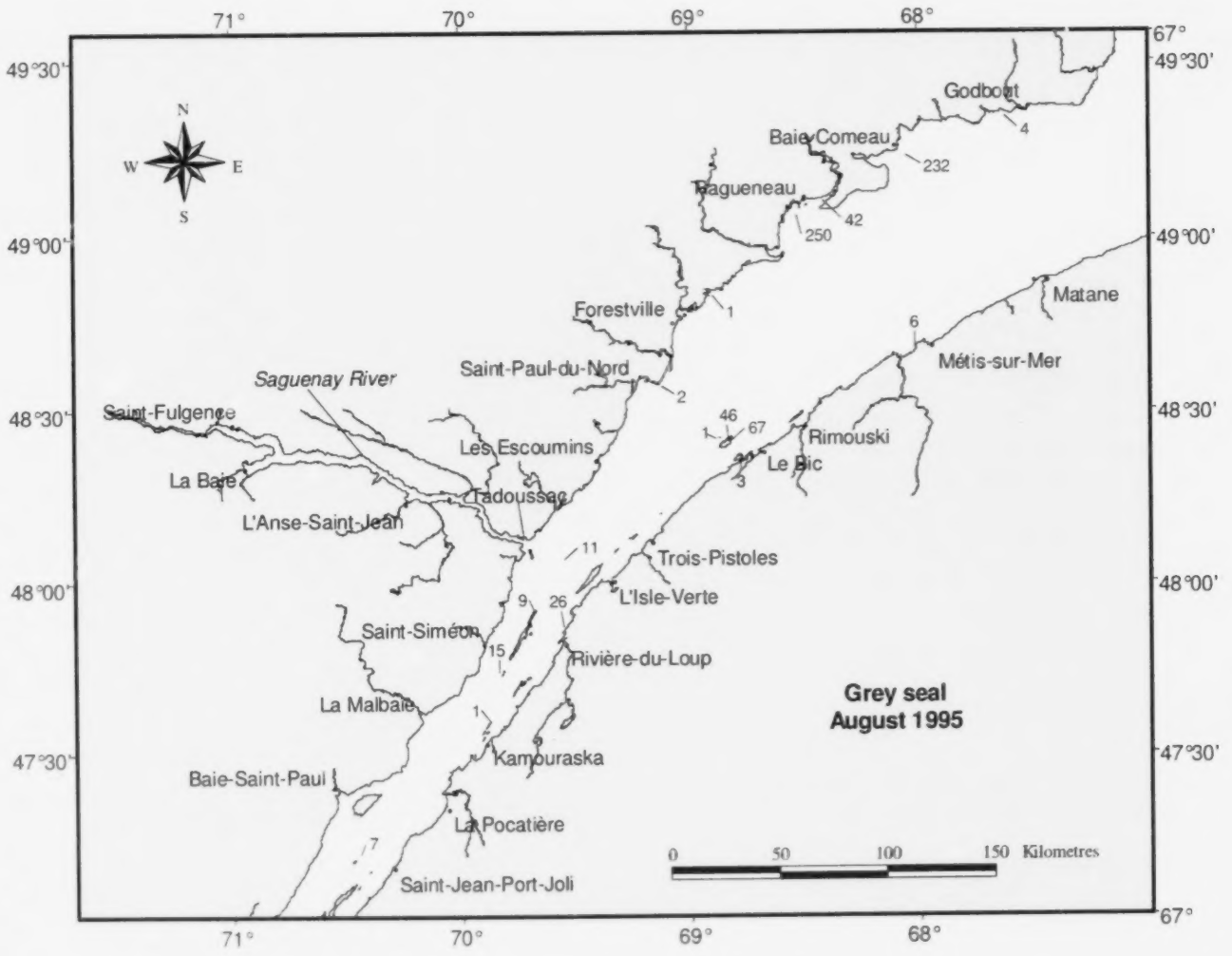
Distribution and abundance

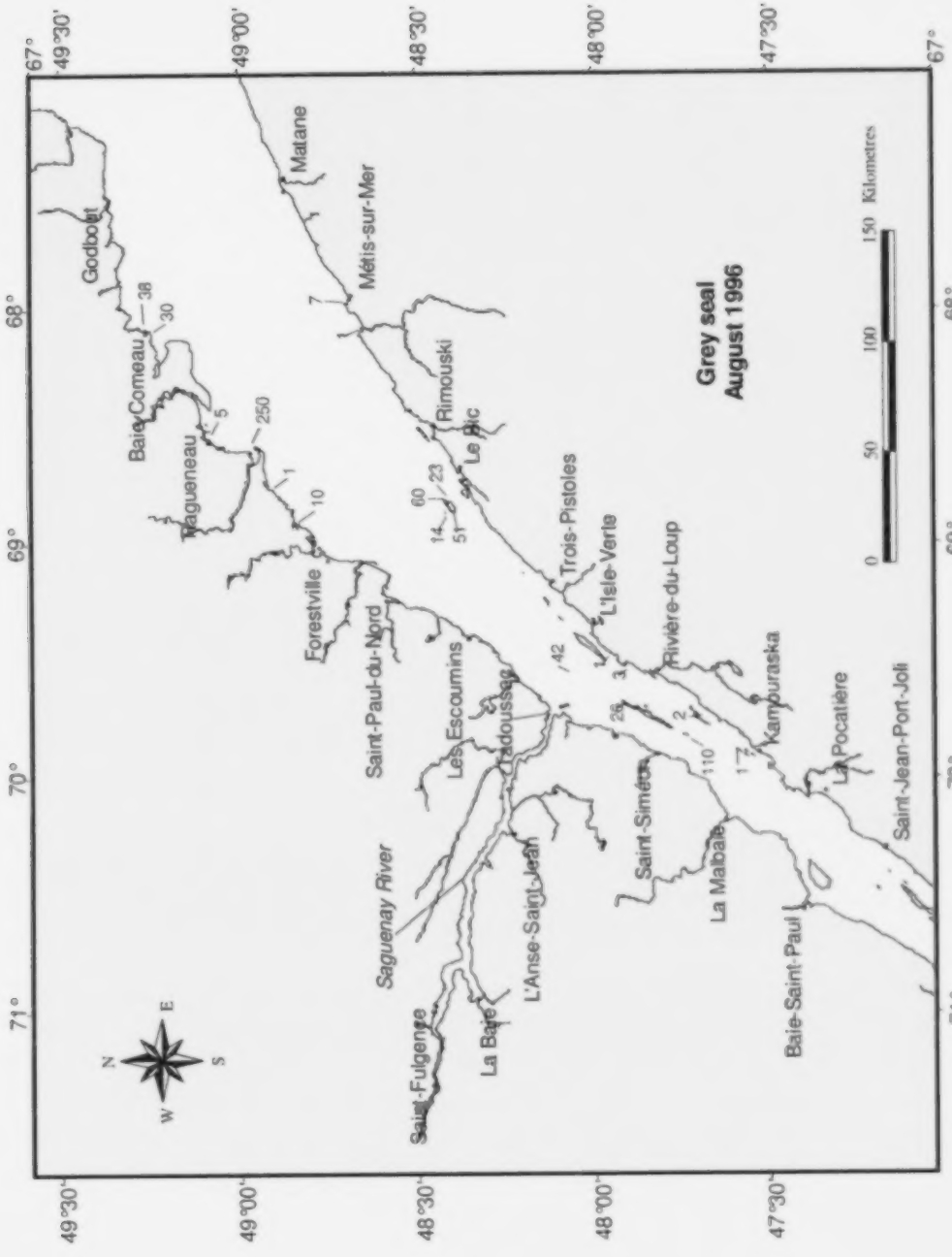

71°
70°
69°
68°
67°
49°30'
49°00'
48°30'
48°00'
47°30'
N
W
E
S
Godbout
Baie-Comeau
11
Pagueneau
115
Matane
Forestville
Saint-Paul-du-Nord
Métis-sur-Mer
Saguenay River
Saint-Fulgence
39
2
Rimouski
Les Escoumins
Le Bic
La Baie
Tadoussac
68
L'Anse-Saint-Jean
Trois-Pistoles
4
L'Isle-Verte
Saint-Siméon
29
Rivière-du-Loup
Grey seal
June 1995
La Malbaie
Kamouraska
Baie-Saint-Paul
La Pocatière
0
50
100
150
Kilometres
Saint-Jean-Port-Joli

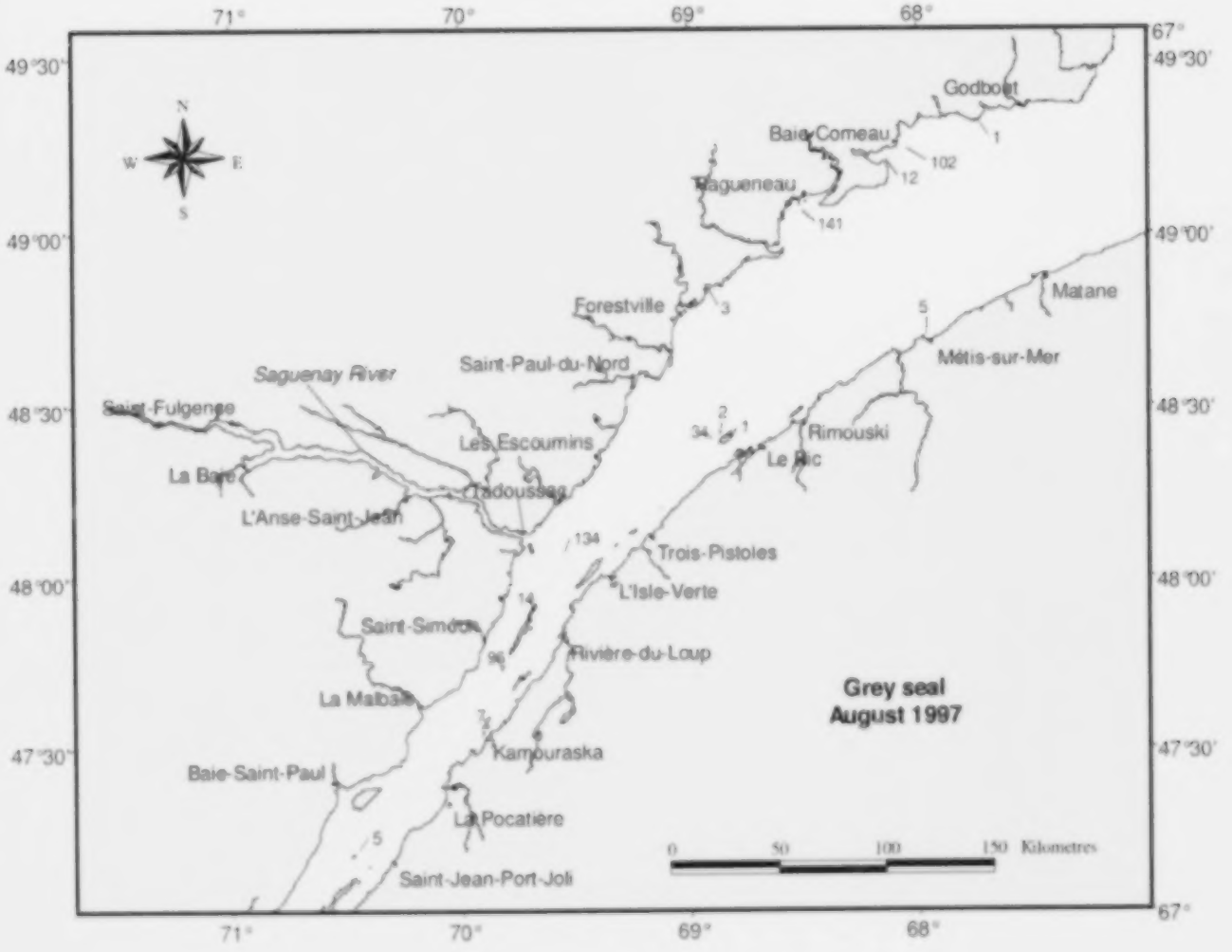

Grey seal
June 1996
Godbout
Baie-Comeau
Hauteneau
Forestville
Saint-Paul-du-Nord
Les Escoumins
Tadoussac
Saguenay River
L'Anse-Saint-Jean
La Baie
Saint-Fulgence
Matane
Métis-sur-Mer
Rimouski
Le Bic
Trois-Pistoles
L'Isle-Verte
Rivière-du-Loup
Kamouraska
La Pocatière
Saint-Jean-Port-Joli
Saint-Siméon
La Malbaie
Baie-Saint-Paul
150
10
4
9
10
52
1
0
50
100
150 Kilometres
N
E
S
W
67°
68°
69°
70°
71°
49°30'
49°00'
48°30'
48°00'
47°30'


71°
70°
69°
68°
67°
49°30'
49°00'
48°30'
48°00'
47°30'
N
W
E
S
Godbout
Baie-Comeau
Tagueneau
275
Forestville
Matane
Métis-sur-Mer
Saguenay River
Saint-Paul-du-Nord
Saint-Fulgence
Les Escoumins
38
4
Rimouski
Le Bic
La Baie
Tadoussac
2
L'Anse-Saint-Jean
Trois-Pistoles
L'Isle-Verte
Saint-Siméon
Rivière-du-Loup
35
La Malbaie
Grey seal
June 2000
Kamouraska
Baie-Saint-Paul
La Pocatière
0
50
100
150
Kilometres
Saint-Jean-Port-Joli


Grey seal
August 1994
Godbout
Baie-Comeau
Hagueneau
Forestville
Saint-Paul-du-Nord
Saguenay River
Saint-Fulgence
La Baie
L'Anse-Saint-Jean
Les Escoumins
Tadoussac
Saint-Siméon
La Malbaie
Baie-Saint-Paul
Matane
Métis-sur-Mer
Rimouski
Le Bic
Trois-Pistoles
L'Isle-Verte
Rivière-du-Loup
Kamouraska
La Pocatière
Saint-Jean-Port-Joli
0 50 100 150 Kilometres
N
E
S
W
67°
68°
69°
70°
71°
49°30'
49°00'
48°30'
48°00'
47°30'


71°
70°
69°
68°
67°
49°30'
49°00'
48°30'
48°00'
47°30'
N
W
E
S
Godbout
4
Baie-Comeau
232
Hagueneau
42
250
Forestville
1
Matane
6
Métis-sur-Mer
Saguenay River
Saint-Paul-du-Nord
2
Saint-Fulgence
46
67
Rimouski
Le Bic
3
Les Escoumins
La Baie
Tadoussac
L'Anse-Saint-Jean
11
Trois-Pistoles
9
26
L'Isle-Verte
Saint-Siméon
15
Rivière-du-Loup
La Malbaie
1
Grey seal
August 1995
Kamouraska
Baie-Saint-Paul
La Pocatière
7
Saint-Jean-Port-Joli
0
50
100
150
Kilometres


Grey seal
August 1996
Godbout
Baie-Comeau
Pointe-aux-Outardes
Baguaneau
Forestville
Saint-Paul-du-Nord
Saguenay River
Les Escoumins
Tadoussac
La Baie
L'Anse-Saint-Jean
Saint-Fulgence
Matane
Métis-sur-Mer
Rimouski
Le Bic
Trois-Pistoles
L'Isle-Verte
Rivière-du-Loup
Kamouraska
La Pocatière
Saint-Jean-Port-Joli
Saint-Siméon
La Malbaie
Baie-Saint-Paul
0 50 100 150 Kilometres
N
E
S
W
67°
68°
69°
70°
71°
49°30'
49°00'
48°30'
48°00'
47°30'


71°
70°
69°
68°
67°
49°30'
49°00'
48°30'
48°00'
47°30'
N
W
E
S
Godbout
Baie-Comeau
Hagueneau
Forestville
Matane
Métis-sur-Mer
Saguenay River
Saint-Paul-du-Nord
Saint-Fulgence
La Baie
Les Escoumins
Tadoussac
L'Anse-Saint-Jean
Rimouski
Le Bic
Trois-Pistoles
L'Isle-Verte
Saint-Simon
Rivière-du-Loup
La Malbaie
Kamouraska
Baie-Saint-Paul
La Pocatière
Saint-Jean-Port-Joli
Grey seal
August 1997
0 50 100 150 Kilometres

APPENDIX III.1.2

Grey seal sightings in the St. Lawrence Estuary and Saguenay River

Number of individuals observed at each haul-out site during each survey with associated haul-out substrate. Map, zone, site IDs, and number of sightings in the table refer to material presented in appendices III.1.1 and III.1.3.

Appendix III.1.2

Map ID	Zone ID	Site ID	Area	June			August				Substrate
				1995	1996	2000	1994	1995	1996	1997	
1	1	1	Reef 7 Pointe Mitis	0	0	0	2	0	0	0	r
1	1	2	East of Pointe Mitis	0	0	0	0	4	0	4	ir
1	1	3	West of Pointe Mitis	0	0	0	0	2	7	1	r
1	2	4	Baie Mitis	0	0	0	0	0	1	0	ir, r
2	3	5	Anse à l'Orignal	0	0	0	0	3	0	1	ir
2	3	6	Récif de l'Orignal	0	1	0	0	0	0	0	r
3	3	7	Récif du Sud-Est	2	4	4	44	67	23	1	r
3	3	8	Récif du Nord-Est	0	0	0	0	46	60	0	r
3	3	9	Île Bicquette	0	0	0	0	0	14	2	r
3	3	10	Récif du Nord-Ouest	39	0	38	0	0	0	34	r
3	3	11	Récif de l'Ouest	0	10	0	0	1	0	0	r
3	3	12	NW reef of W point of Île du Bic	0	9	0	0	0	0	0	r
3	3	13	W point of Île du Bic	0	0	0	1	0	51	0	r
4	4	14	Razade d'en Bas	68	0	2	0	0	0	0	r
5	5	15	NE point of Île Verte	0	7	0	0	0	0	0	ir
5	6	16	Channel of Île Verte	0	0	0	2	0	0	0	ir
5	6	17	Between Île Verte and Gros Cacouna	0	0	0	0	0	1	0	ir
5	9	18	Île Rouge	0	0	0	0	11	42	134	ir
6	7	19	NE point of Rocher Percé	0	0	0	0	0	3	0	ir
6	7	20	SW point of Rocher Percé	0	0	0	16	26	0	0	r
6	8	21	Battures de Rivière-du-Loup	0	0	0	1	0	0	0	ir
6	10	22	N side of Île Blanche	0	0	0	0	1	0	0	ir, r
6	10	23	Île Blanche	4	10	0	2	8	26	14	ir
7	11	24	SW point of Île aux Lièvres	0	52	0	0	0	0	0	r
7	12	25	Île aux Fraises	29	0	35	37	15	110	96	r
7	13	26	Les Pélerins	0	1	0	2	0	1	0	r
7	13	27	Battures de RDL close to Les Pélerins	0	0	0	0	0	1	0	ir
8	14	28	Grande Île- Kamouraska	0	0	0	1	1	1	0	r
8	14	29	W of Île aux Corneilles	0	0	0	0	0	0	7	ir
9	14	30	NE pt of Battures aux Loups Marins	0	0	0	0	7	0	0	ir

ir = isolated rocks; r = reefs; sb = sand banks; cl = rocks at the bottom of a cliff; b = beaches

Appendix III.1.2. (Continued)

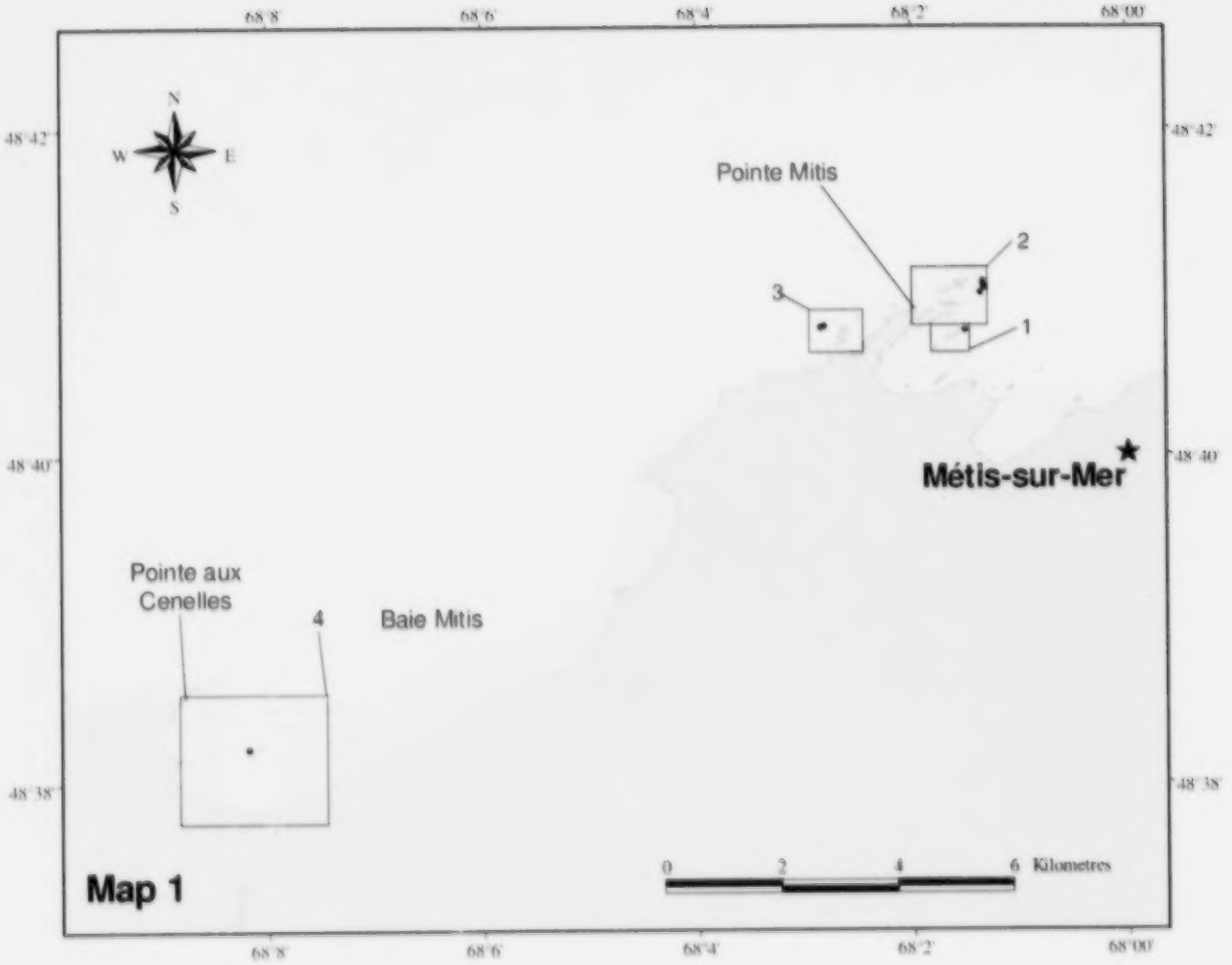
Map ID	Zone ID	Site ID	Area	June			August				Substrate
				1995	1996	2000	1994	1995	1996	1997	
9	15	31	Channel of Battures aux Loups Marins	0	0	0	0	0	0	5	ir
10	16	32	Pointe à Boisvert	0	0	0	0	2	0	0	ir
11	17	33	Battures aux Gibiers	0	0	0	0	1	10	3	r
12	18	34	Îlets Jérémie	0	0	0	0	0	1	0	r
12	19	35	Betsiamites River mouth	0	0	275	0	0	250	0	sb
13	20	36	Île de la Mine	0	0	0	3	0	4	1	r
13	20	37	Sand banks offshore of Île de la Mine	115	150	0	0	250	1	140	sb
13	20	38	Mouth of river at Pointe-aux-Outardes	0	0	0	0	42	0	0	sb
14	21	39	Pointe Saint-Gilles	11	0	0	0	21	30	12	sb
14	21	40	Offshore of Pointe Saint-Gilles	0	0	0	0	211	0	102	sb
14	21	41	Baie des Anglais / Pointe Saint-Gilles	0	0	0	0	0	38	0	sb
15	21	42	Pointe de la Croix	0	0	0	0	0	0	1	ir
15	22	43	Pointe Rouge	0	0	0	0	4	0	0	ir

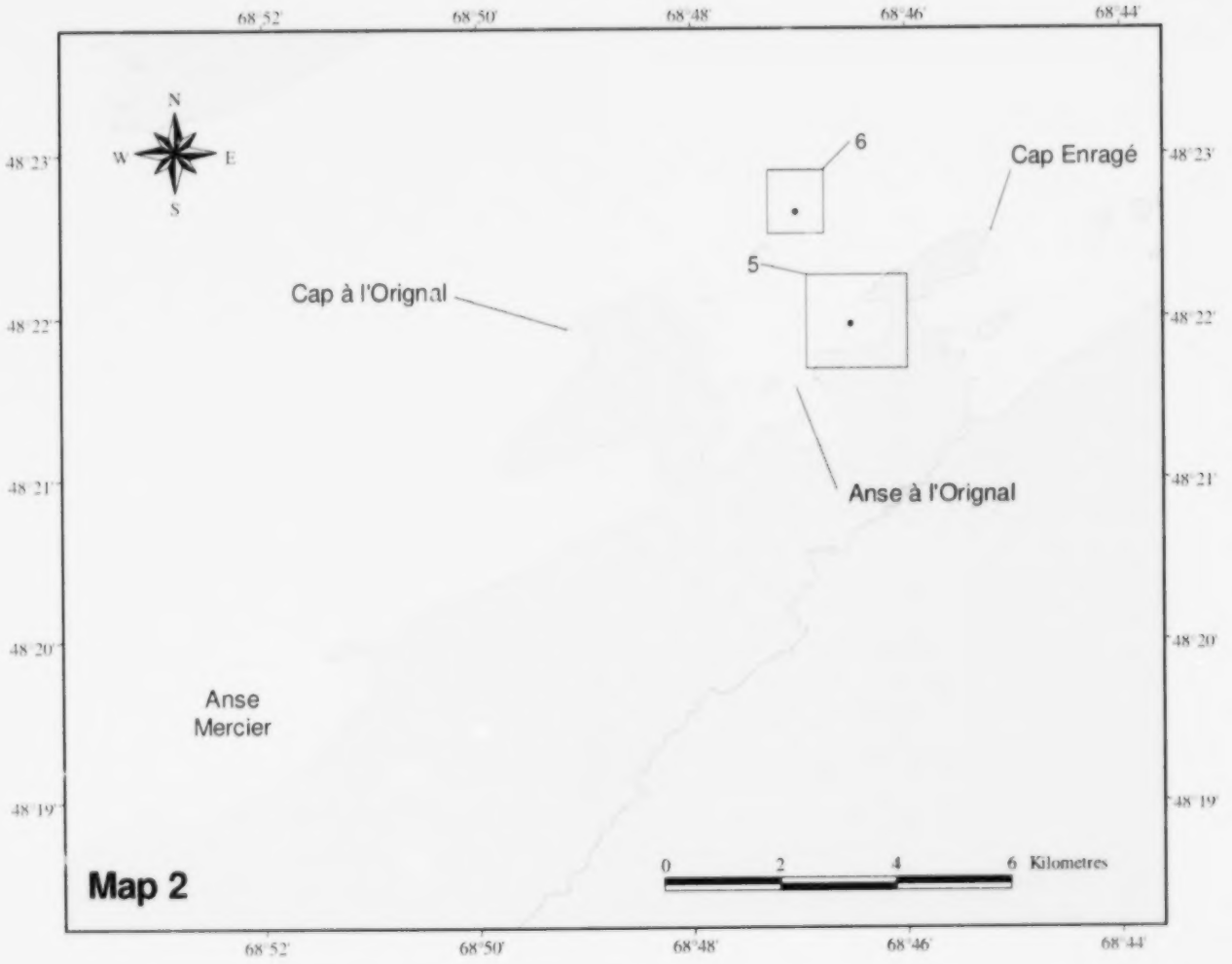
ir = isolated rocks; r = reefs; sb = sand banks; cl = rocks at the bottom of a cliff; b = beaches

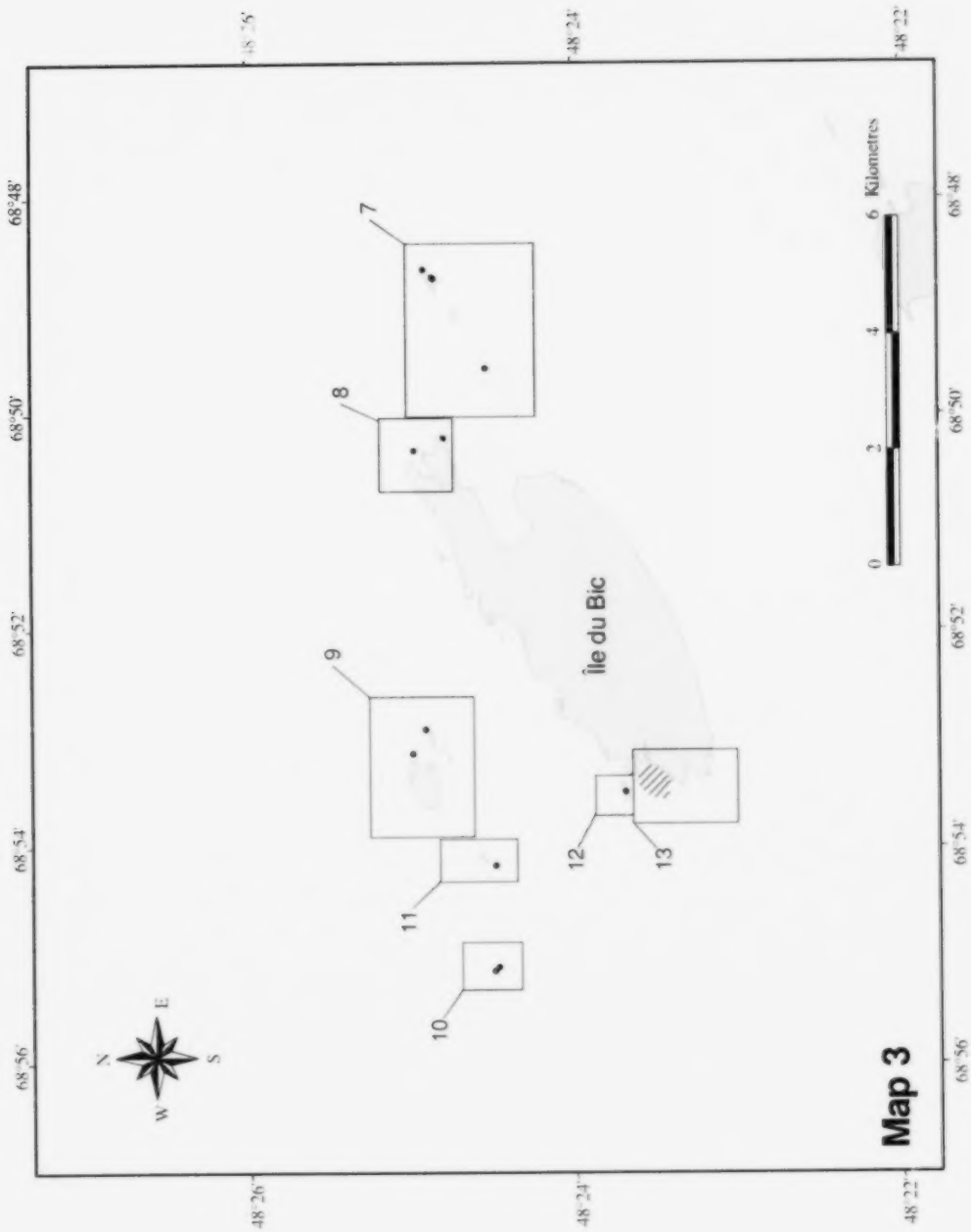
APPENDIX III.1.3

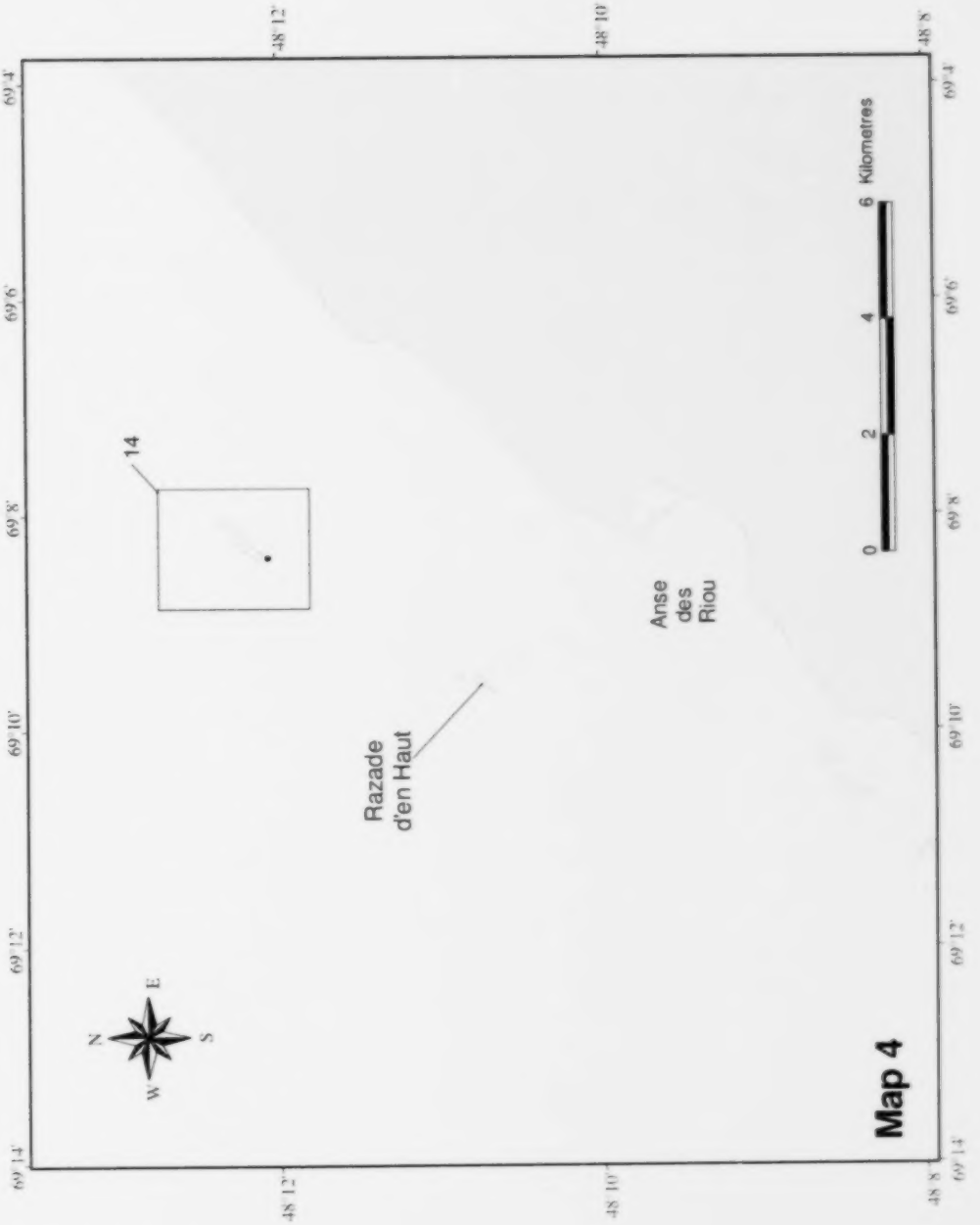
Grey seal sightings in the St. Lawrence Estuary and Saguenay River, 1994–2000

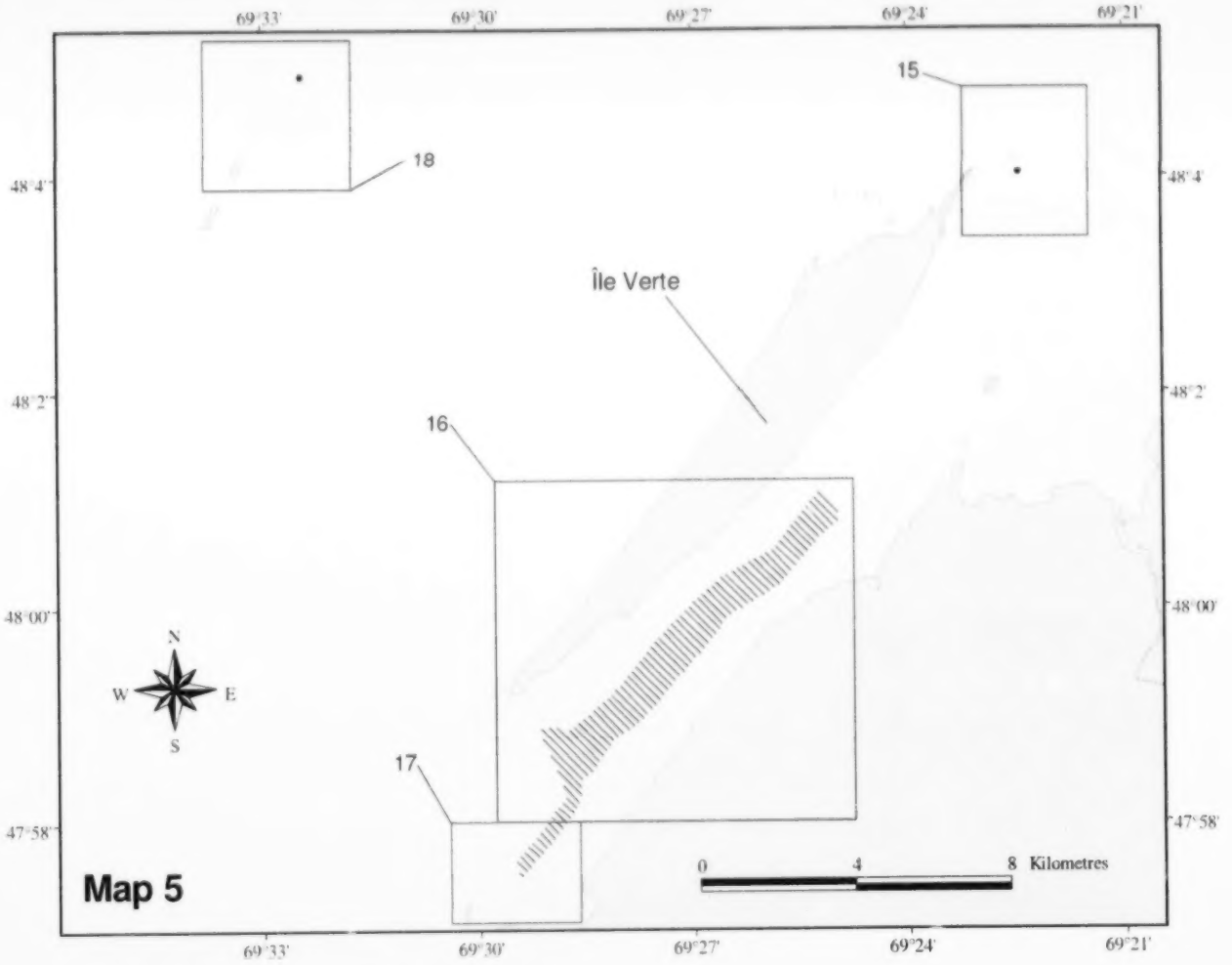
Location of grey seal sightings (dots). The numbers associated with each haul-out area (rectangles) refer to site ID numbers in Appendix III.1.2, where the number of individuals observed at each site is presented. Areas where haul-out sites are more spread out, often as a series of isolated rocks or small reefs, are indicated with dashed lines. The paler shaded zones represent areas exposed at low tide.


68°8'
68°6'
68°4'
68°2'
68°00'
48°42'
48°40'
48°38'
N
W
E
S
Pointe Mitis
1
2
3
Métis-sur-Mer
Pointe aux
Cenelles
4
Baie Mitis
0
2
4
6 Kilometres
Map 1

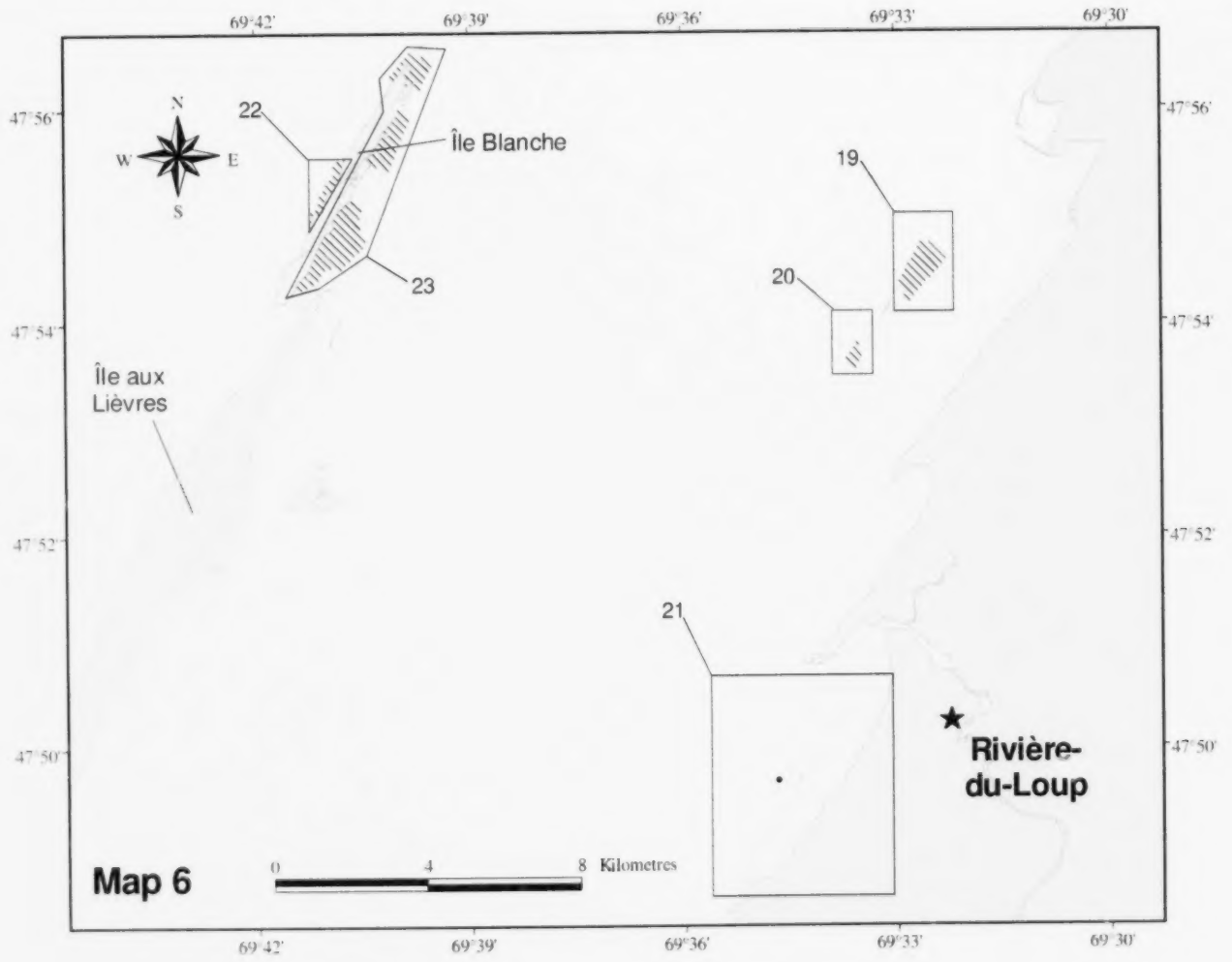

68°52'
68°50'
68°48'
68°46'
68°44'
N
W
E
S
48°23'
48°22'
48°21'
48°20'
48°19'
6
5
Cap Enragé
Cap à l'Orignal
Anse à l'Orignal
Anse
Mercier
0
2
4
6 Kilometres
Map 2

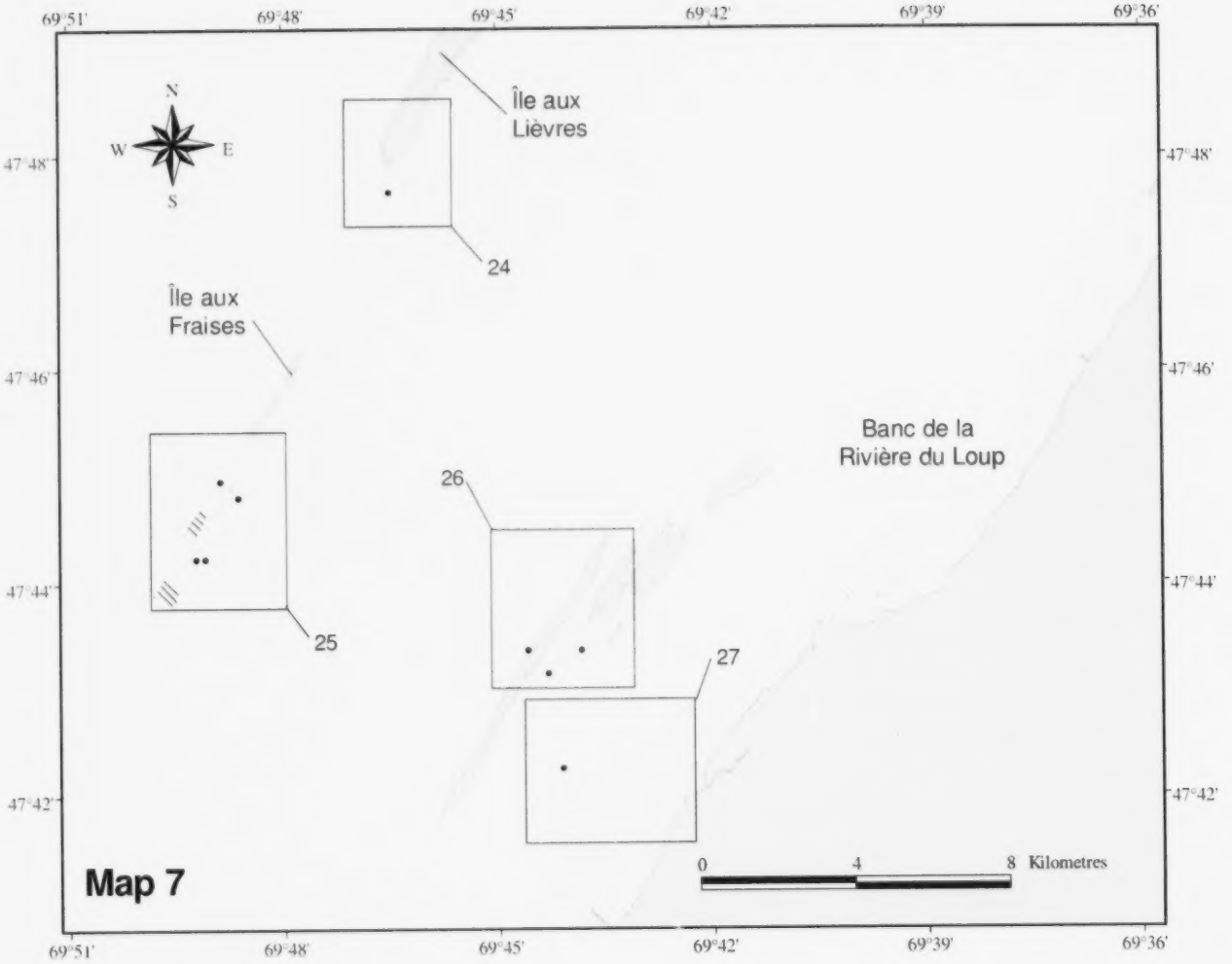

68°56'
68°54'
68°52'
68°50'
68°48'
48°26'
48°24'
48°22'
N
E
S
W
7
8
9
10
11
12
13
Île du Bic
0
2
4
6 Kilometres
Map 3

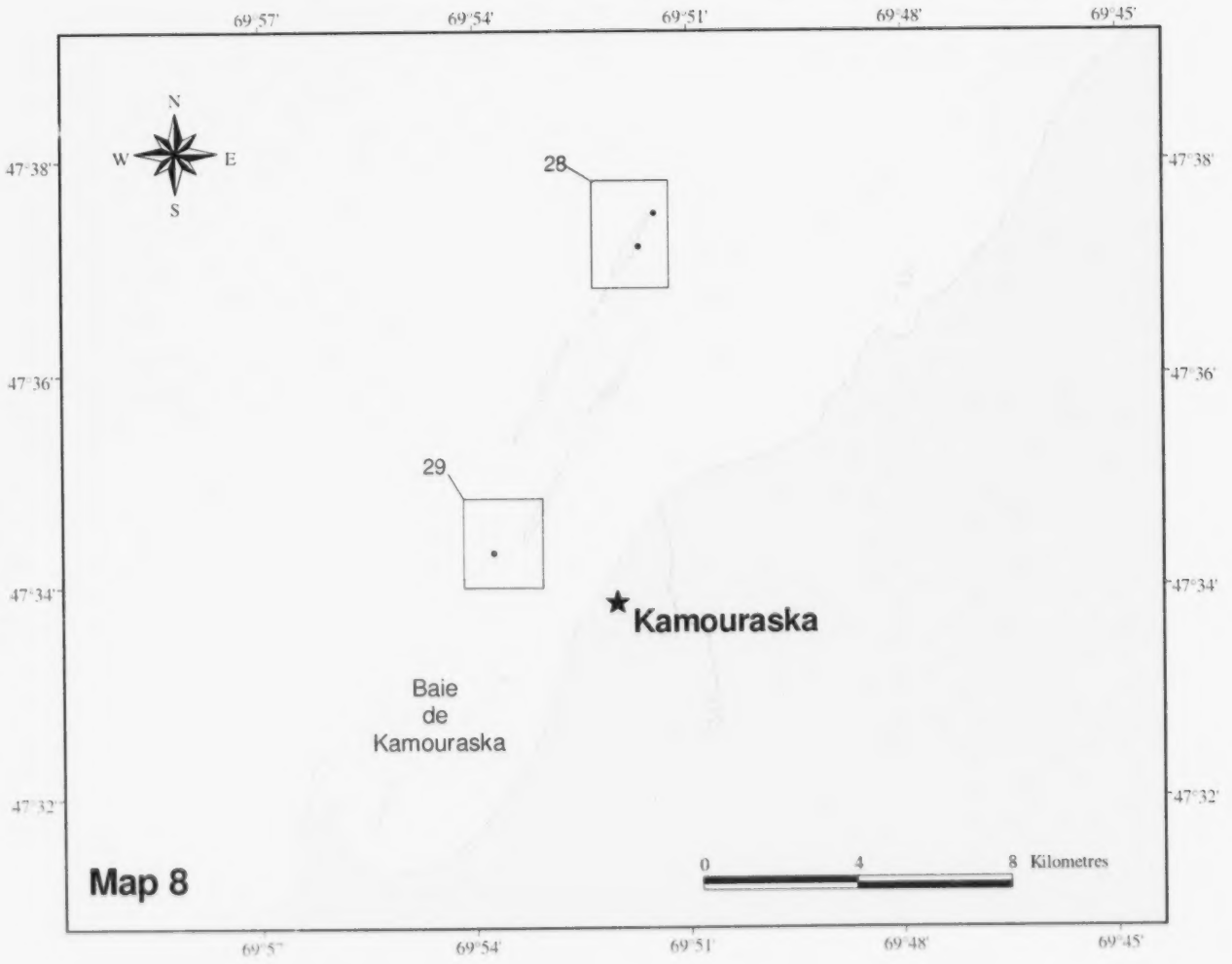

69° 14'
69° 12'
69° 10'
69° 8'
69° 6'
69° 4'
48° 12'
48° 10'
48° 8'
14
Razade
d'en Haut
Anse
des
Riou
N
E
S
W
0
2
4
6 Kilometres
Map 4

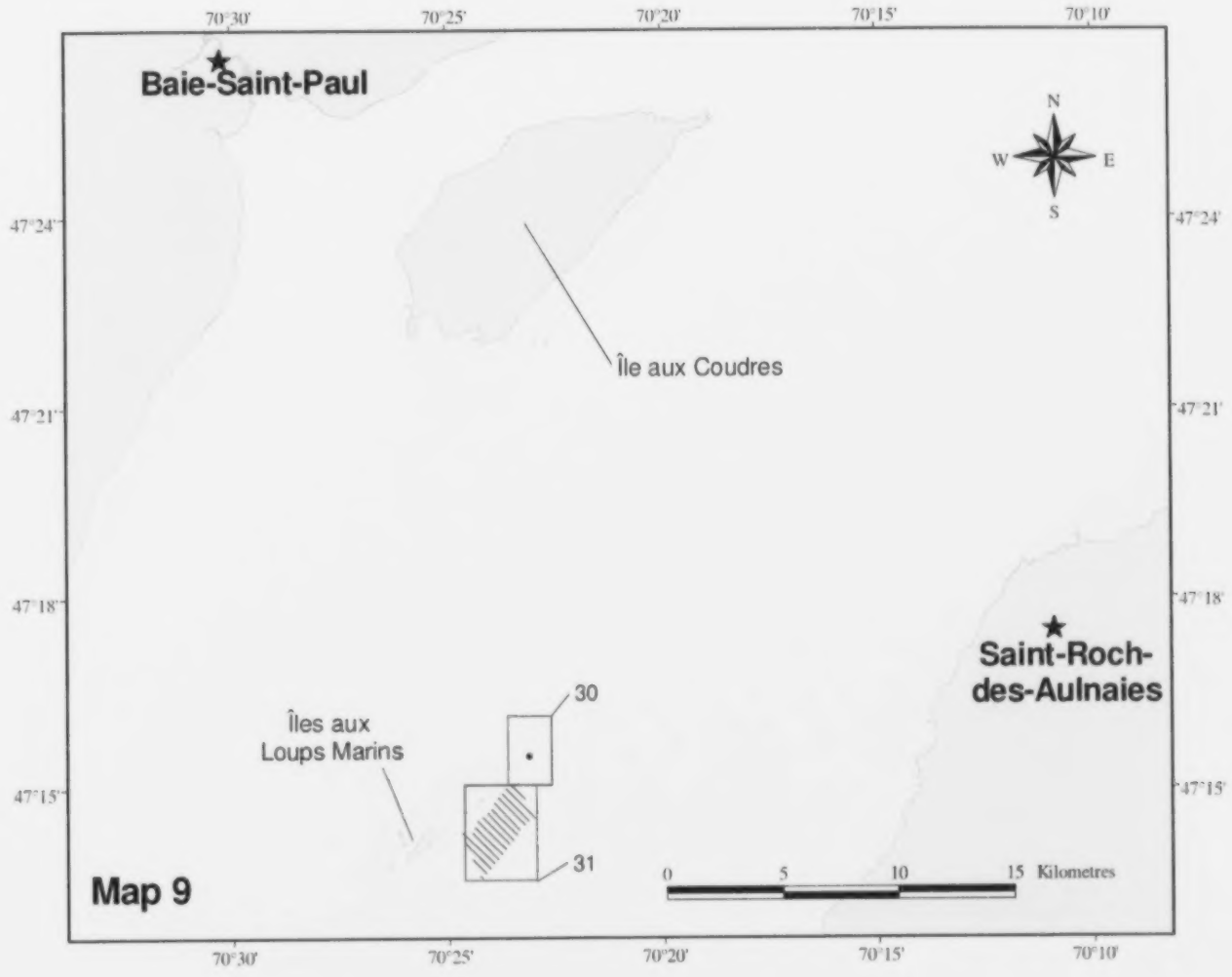

69°33'
69°30'
69°27'
69°24'
69°21'
48°4'
48°2'
48°00'
47°58'
15
18
16
17
Île Verte
N
W
E
S
0
4
8 Kilometres

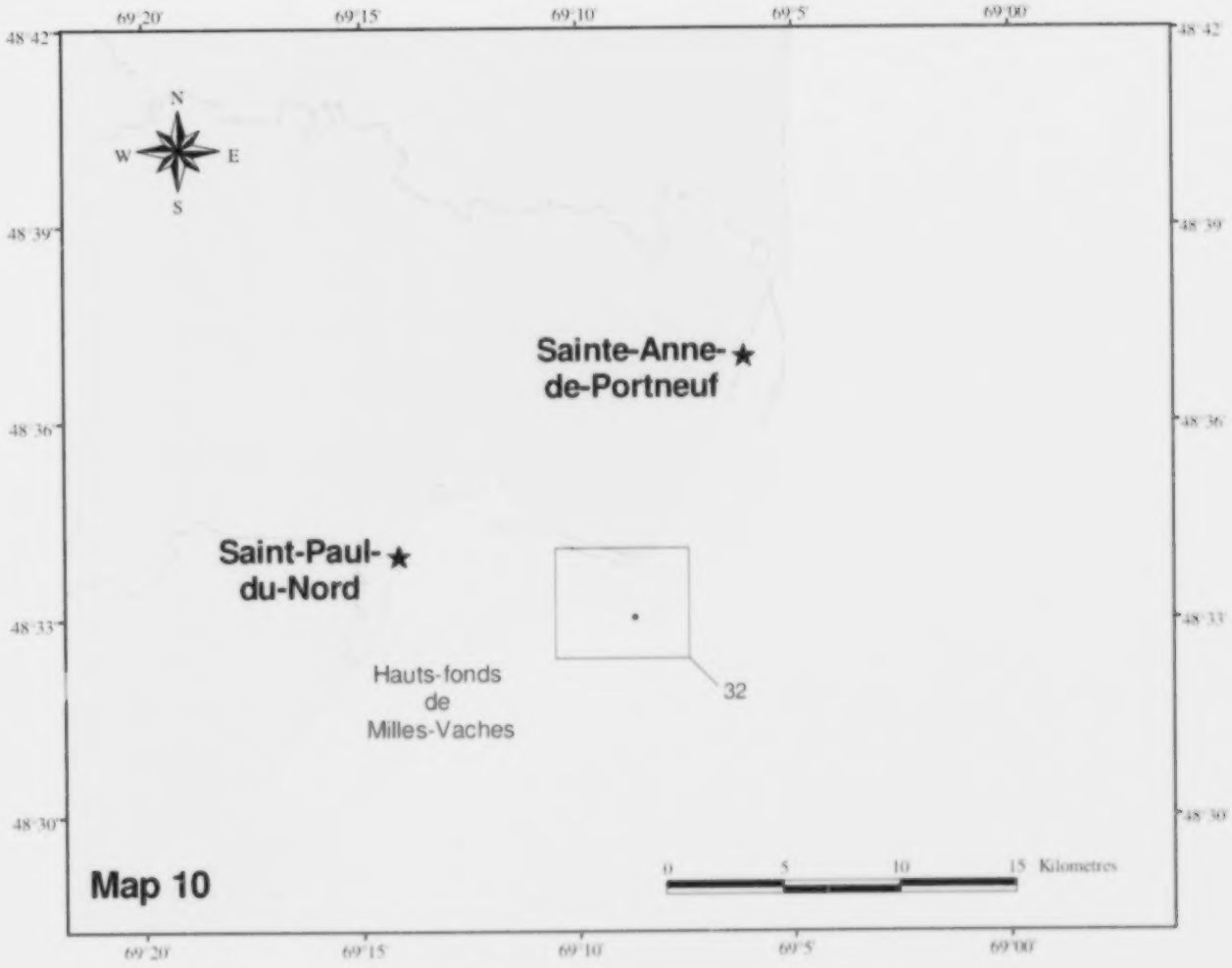
Map 5

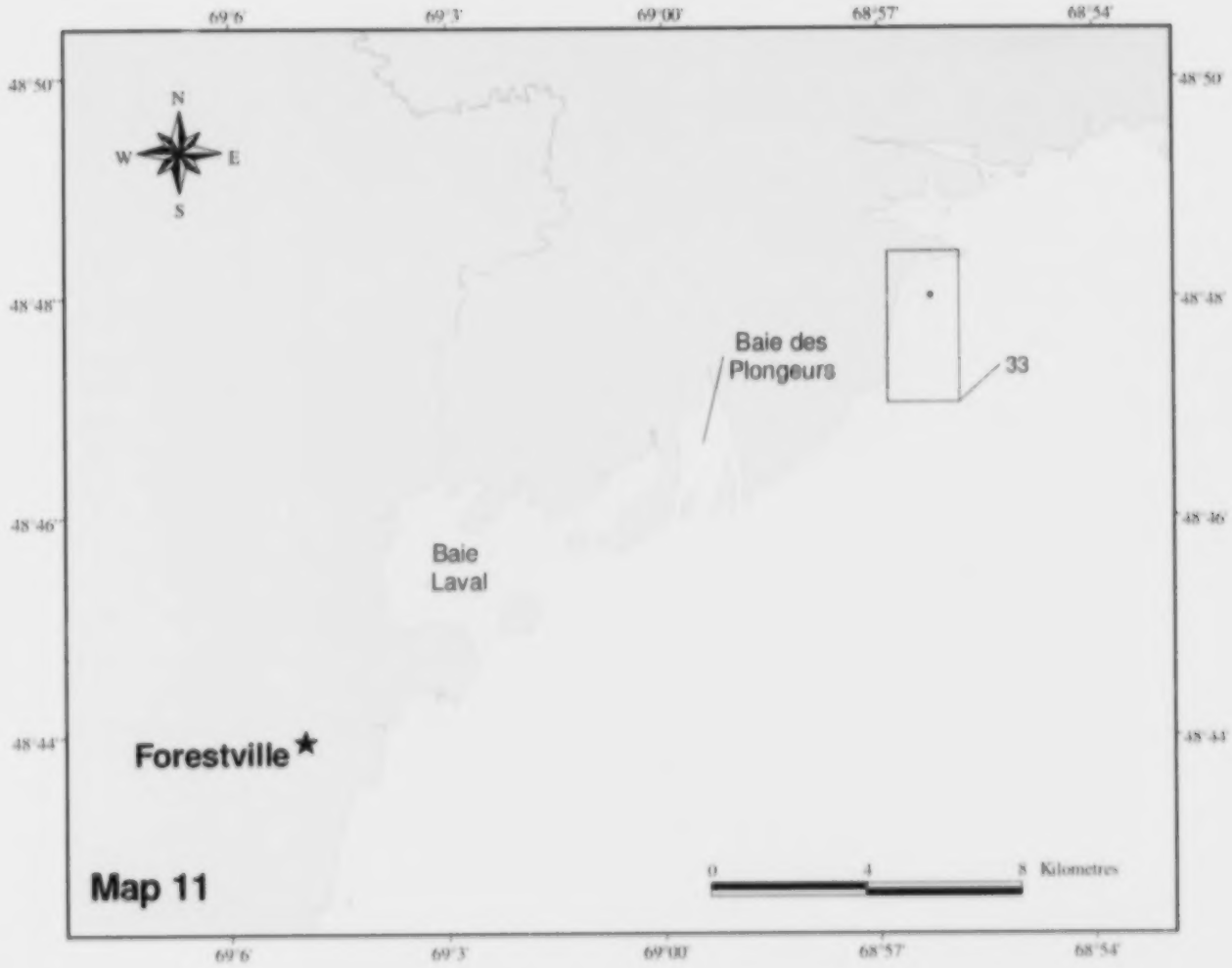

69°42'
69°39'
69°36'
69°33'
69°30'
47°56'
47°54'
47°52'
47°50'
N
W
E
S
22
23
Île Blanche
19
20
Île aux
Lièvres
21
Rivière-
du-Loup
Map 6
0
4
8 Kilometres

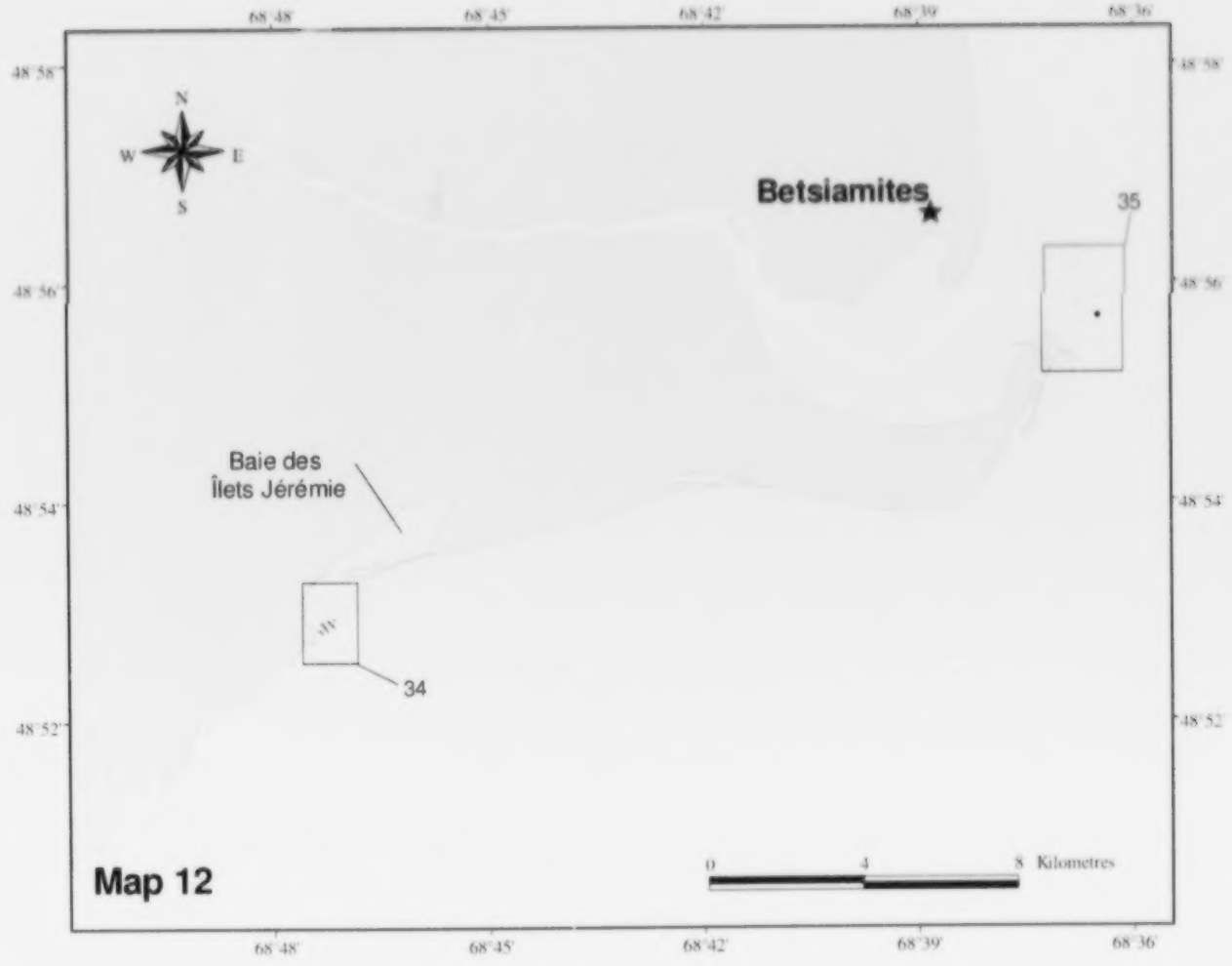

69°51'
69°48'
69°45'
69°42'
69°39'
69°36'
47°48'
47°46'
47°44'
47°42'
N
W
E
S
Île aux
Lièvres
24
Île aux
Fraises
25
26
27
Banc de la
Rivière du Loup
0
4
8 Kilometres
Map 7

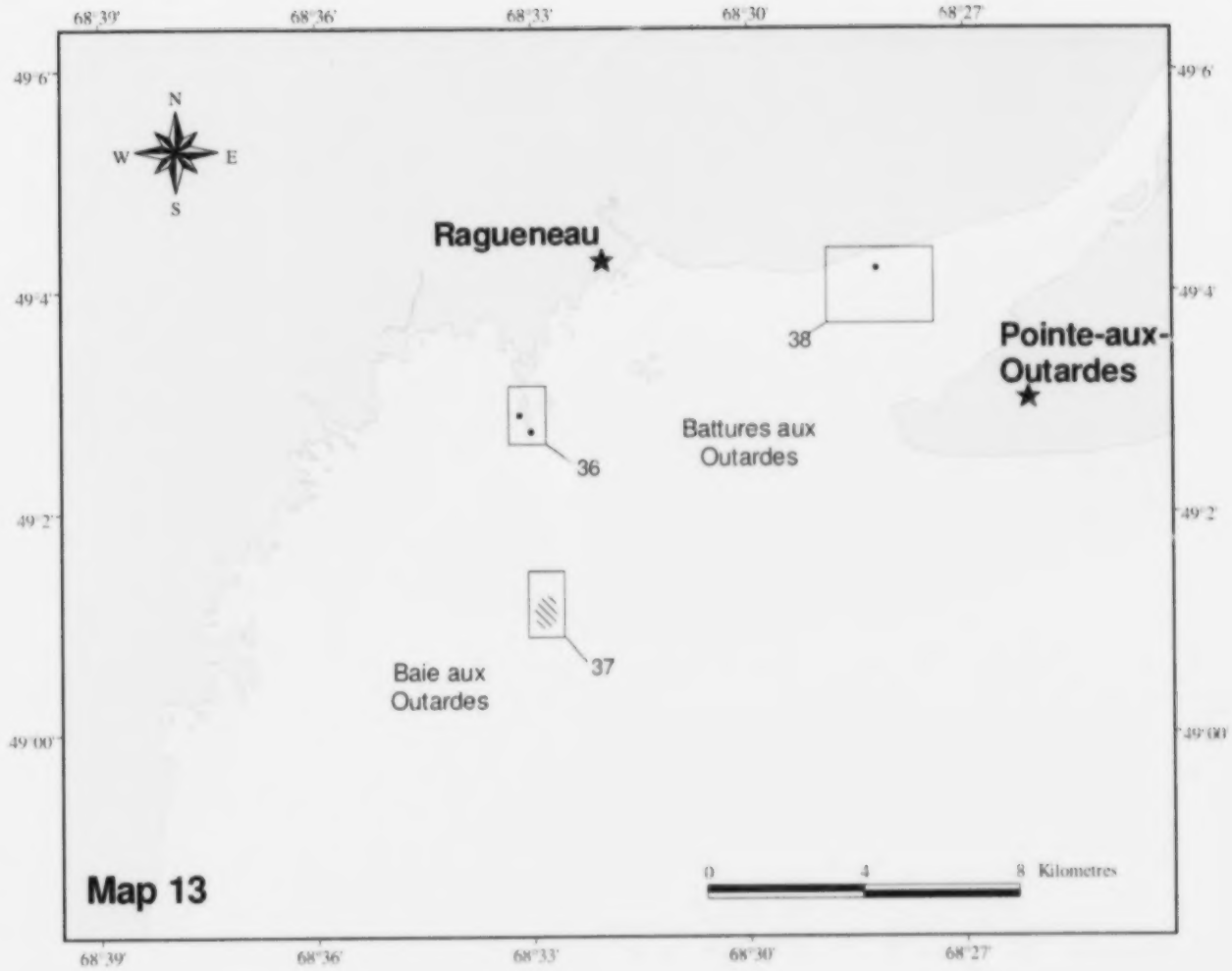

69°57'
69°54'
69°51'
69°48'
69°45'
N
W
E
S
47°38'
47°36'
47°34'
47°32'
28
29
Kamouraska
Baie
de
Kamouraska
0
4
8 Kilometres
Map 8

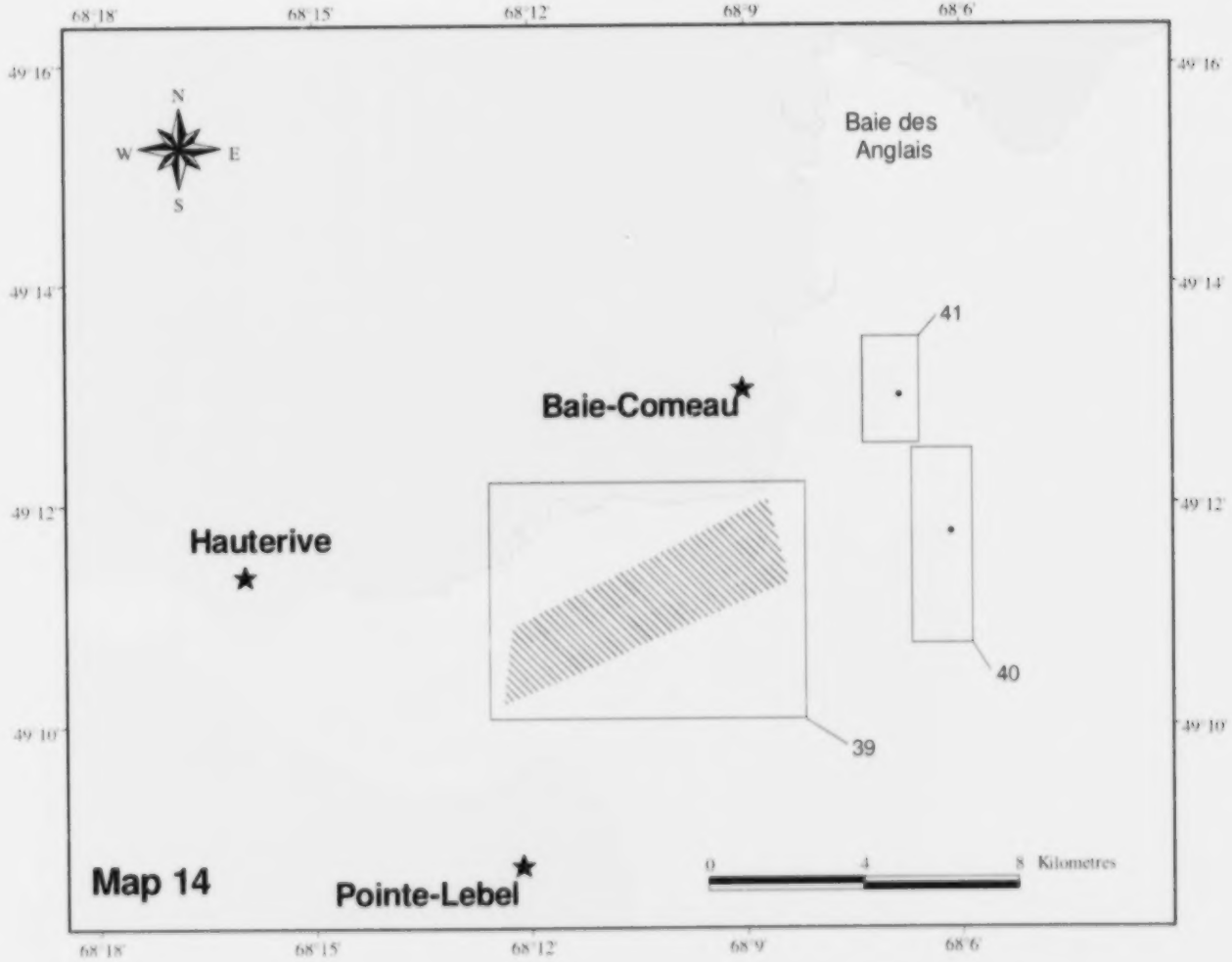

70°30'
70°25'
70°20'
70°15'
70°10'
Baie-Saint-Paul
N
W
E
S
47°24'
47°21'
47°18'
47°15'
Île aux Coudres
Saint-Roch-
des-Aulnaies
Îles aux
Loups Marins
30
31
0
5
10
15 Kilometres
Map 9


69°20'
69°15'
69°10'
69°5'
69°00'
48°42'
48°39'
48°36'
48°33'
48°30'
N
W
E
S
Sainte-Anne-de-Portneuf
Saint-Paul-du-Nord
Hauts-fonds de Milles-Vaches
32
0
5
10
15 Kilometres
Map 10

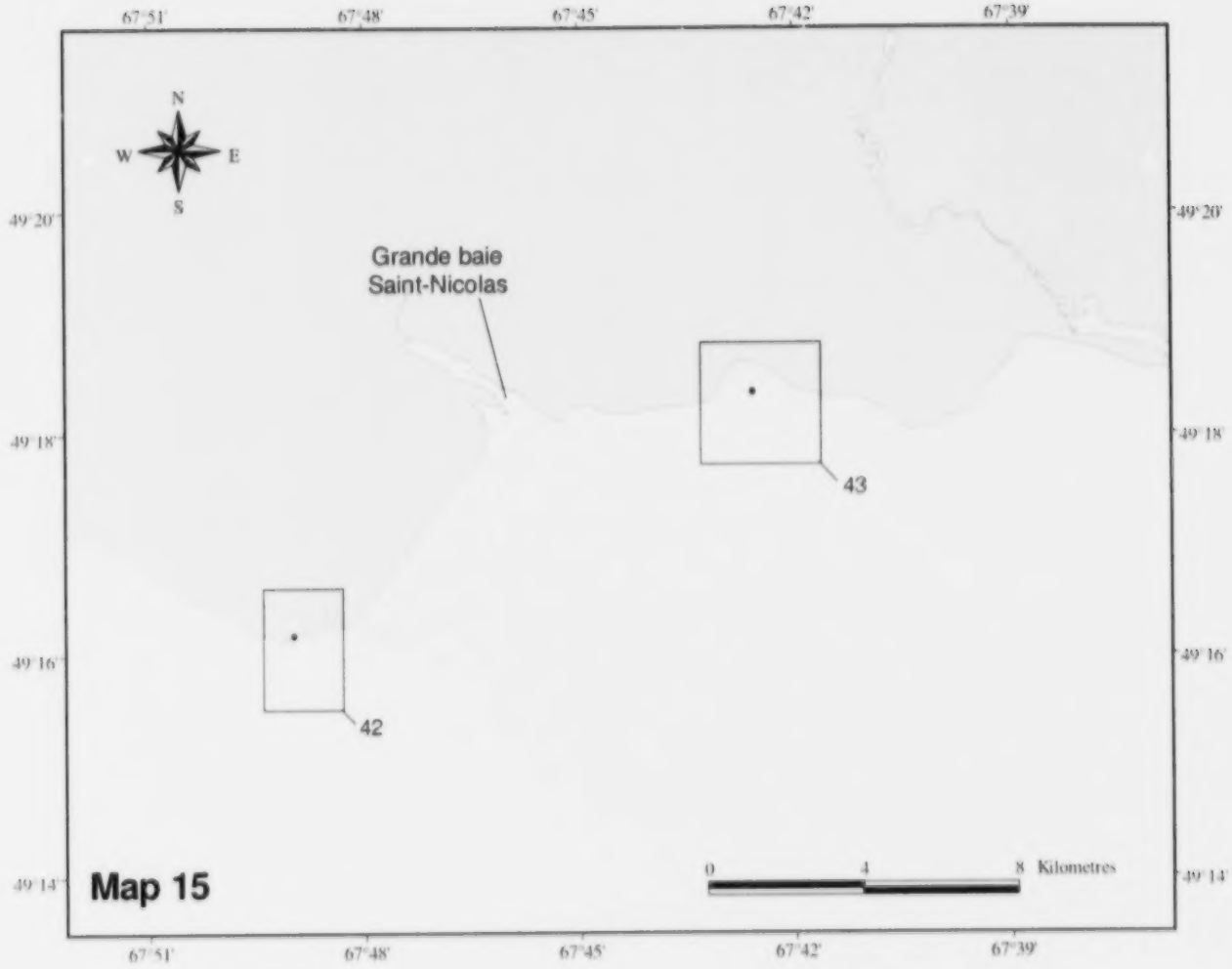

69°6'
69°3'
69°00'
68°57'
68°54'
48°50'
48°48'
48°46'
48°44'
N
W
E
S
Baie des
Plongeurs
33
Baie
Laval
Forestville
Map 11
0
4
8 Kilometres


68°48'
68°45'
68°42'
68°39'
68°36'
48°58'
48°56'
48°54'
48°52'
N
W
E
S
Betsiamites
35
Baie des
Îlets Jérémie
34
0
4
8 Kilometres
Map 12


68°39'
68°36'
68°33'
68°30'
68°27'
49°6'
49°4'
49°2'
49°00'
N
W
E
S
Ragueneau
38
Pointe-aux-Outardes
Battures aux Outardes
36
37
Baie aux Outardes
0
4
8 Kilometres
Map 13


68°18'
68°15'
68°12'
68°9'
68°6'
49°16'
49°14'
49°12'
49°10'
N
W
E
S
Baie des
Anglais
Baie-Comeau
Hauterive
Pointe-Lebel
41
40
39
0
4
8 Kilometres

Map 14


67°51'
67°48'
67°45'
67°42'
67°39'
N
W
E
S
49°20'
49°18'
49°16'
49°14'
Grande baie
Saint-Nicolas
43
42
0
4
8 Kilometres

Map 15

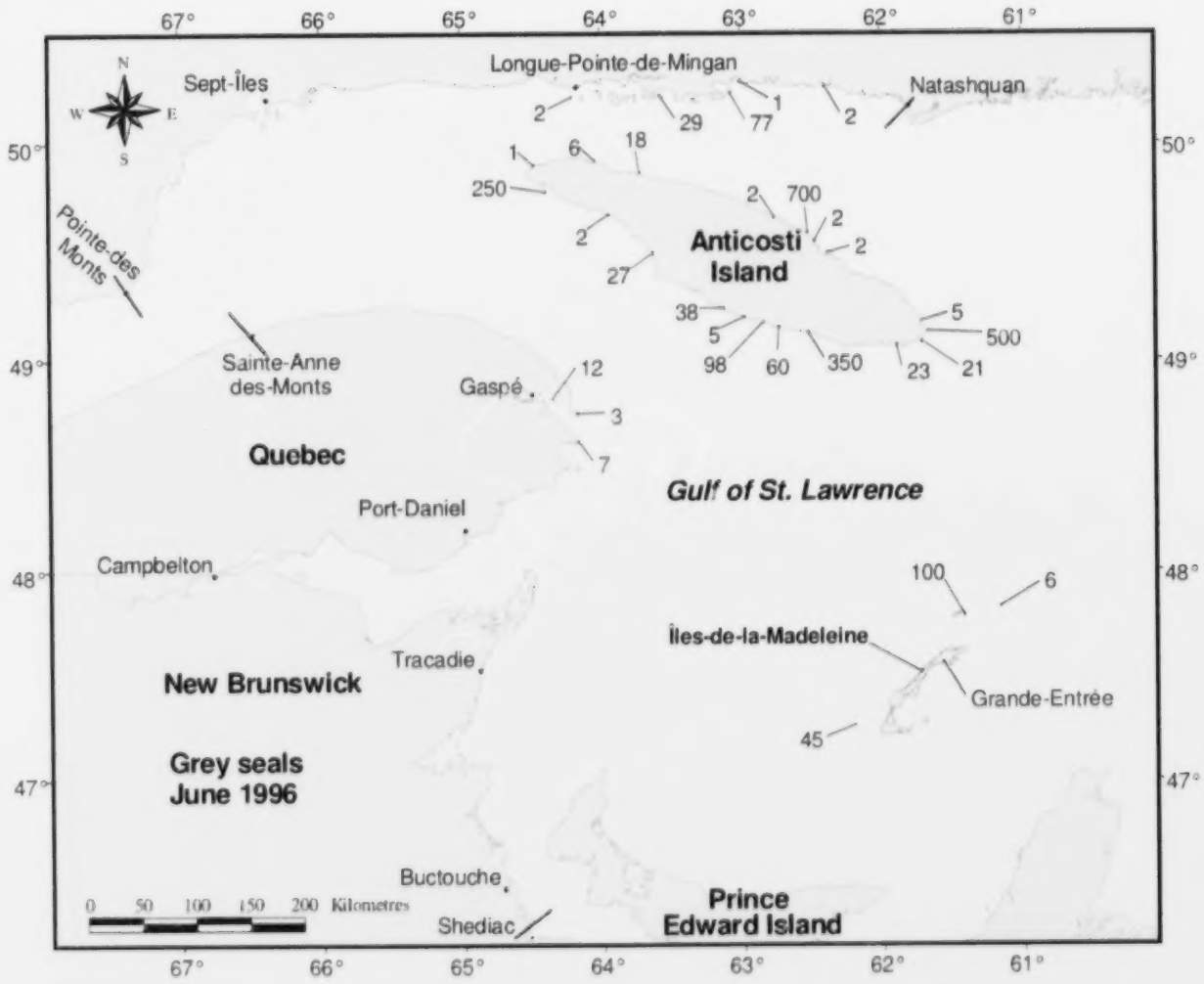
APPENDIX III.2

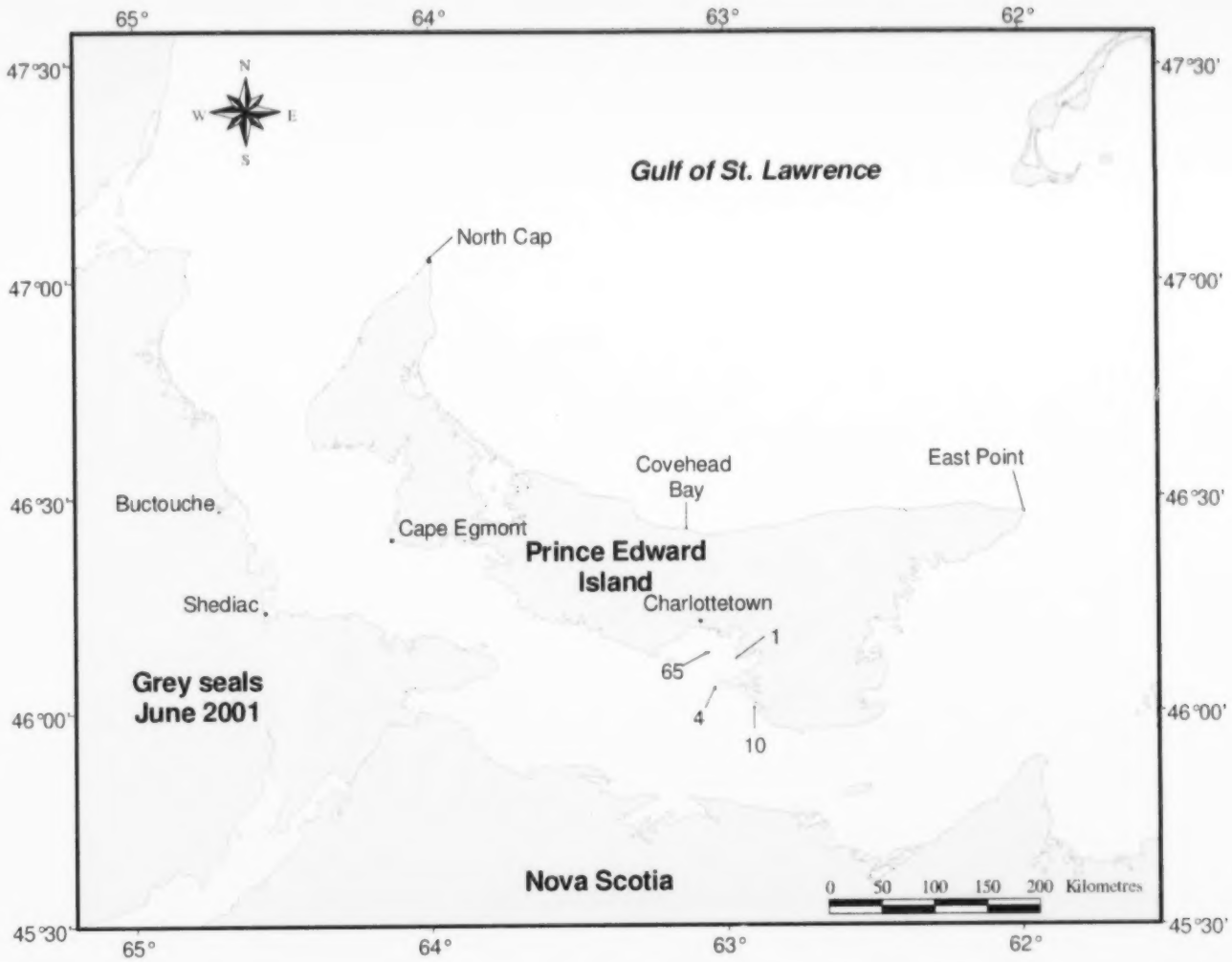
Grey seals in the Gulf of St. Lawrence in 1996 and 2001

APPENDIX III.2.1

Grey seal sightings in the Gulf of St. Lawrence

Distribution and abundance


67°
66°
65°
64°
63°
62°
61°
50°
49°
48°
47°
N
W
E
S
Sept-Îles
Longue-Pointe-de-Mingan
Natashquan
2
29
77
1
2
1
6
18
250
2
700
2
2
2
27
Anticosti
Island
38
5
5
500
98
60
350
23
21
Pointe-des
Monts
Sainte-Anne
des-Monts
Gaspé
12
3
7
Quebec
Gulf of St. Lawrence
Port-Daniel
Campbelton
100
6
Îles-de-la-Madeleine
Tracadie
New Brunswick
Grande-Entrée
45
Grey seals
June 1996
Buctouche
0 50 100 150 200 Kilometres
Shediac
Prince
Edward Island


65°
64°
63°
62°
47°30'
47°00'
46°30'
46°00'
45°30'
N
W
E
S
Gulf of St. Lawrence
North Cap
Covehead Bay
East Point
Buctouche
Cape Egmont
Prince Edward Island
Shediac
Charlottetown
1
65
4
10
Grey seals June 2001
Nova Scotia
0 50 100 150 200 Kilometres

APPENDIX III.2.2

Grey seal sightings in the Gulf of St. Lawrence

Number of individuals observed at each haul-out site during each survey with associated haul-out substrate. Zone IDs in the table refer to material presented in Figure 6.

Appendix III.2.2

Zone ID	Area (name or position lat.°N, long.°W)	June 1996	June 2001	Substrate
1	rocks just off the cliff 48°48.96 64°16.75	4	-	cl
1	between 48°45 64°08 and 48°47 64°12.5	3	-	cl
1	half-way between Petit Cap-aux-Os and Penouille	8	-	ir
2	SE point of Île Plate	7	-	i
3	Gallas Point	-	1	w
3	NW of Point Prim-about 500m off shore	-	2	w
3	about 1 km NW of Point Prim	-	2	w
3	East point of Governors island	-	65	ir
4	Big Point	-	10	sb
5	Île Le Corps-Mort, SE side	45	-	w
6	Île Brion - N Point	100	-	ir
7	North Bird (Rocher aux Oiseaux)	6	-	w
8	Cap Henri 49°48 62°26	250	-	r conn land
9	49°40.31 63°56.89	1	-	undetermined
9	49°40.00 63°55.19	1	-	ir
10	49°29.53 63°37.40	2	-	ir
10	49°29 63.37.40	25	-	undetermined
11	49°14.25 63°07.47	3	-	undetermined
11	49°13.32 63°04.40	35	-	undetermined
11	49°11.91 62°57.66	5	-	ir
11	49°10 62°51.7	51	-	undetermined
11	49°10.35 62°49.5	1	-	ir
11	49°09 62°49	46	-	w
11	49°09.19 62°45.7	8	-	w
11	49°09 62°45	27	-	w
11	49°08.73 62°42.17	25	-	ir
11	49°07.08 62°30.85	350	-	r conn land
12	49°03.92 61°56.55 near gravel point	22	-	w
12	49°03.61 61°49.10	1	-	w
12	Pointe Heath	21	-	w
13	49°08.13 61°39.04	500	-	b
13	49°11.11 61°42.69	5	-	w
14	49°29.6 62°21.95	2	-	w
14	49°33.22 62°26.91	2	-	w
14	49°35.37 62°30.53	700	-	cl
15	49°39.8 62°44.45	2	-	w
16	49°52.61 63°44.20	18	-	ir
17	49°56.01 64°02.25	6	-	w
18	49°54.92 64°28.72	1	-	w
19	50°15.08 62°23.11	2	-	r
20	E of entrance to Baie de la Grande Hermine	1	-	r
20	Le Saint Est 50°13 63°00	68	-	undetermined
20	récifs au Marteau	25	-	r
20	SE of Île à la Chasse "rocher de la Garde" 50°11 63°07	9	-	r
20	récifs au Marteau 50°12.6 63°32	4	-	r
20	50°16.22 64°15.00	1	-	w
20	Île aux Perroquets	1	-	w

ir= isolated rocks; i = island; r= reefs; sb= sand banks; cl = rocks or beach at the bottom of a cliff; b = beaches; r conn land = reef connected to land; w = seals in the water